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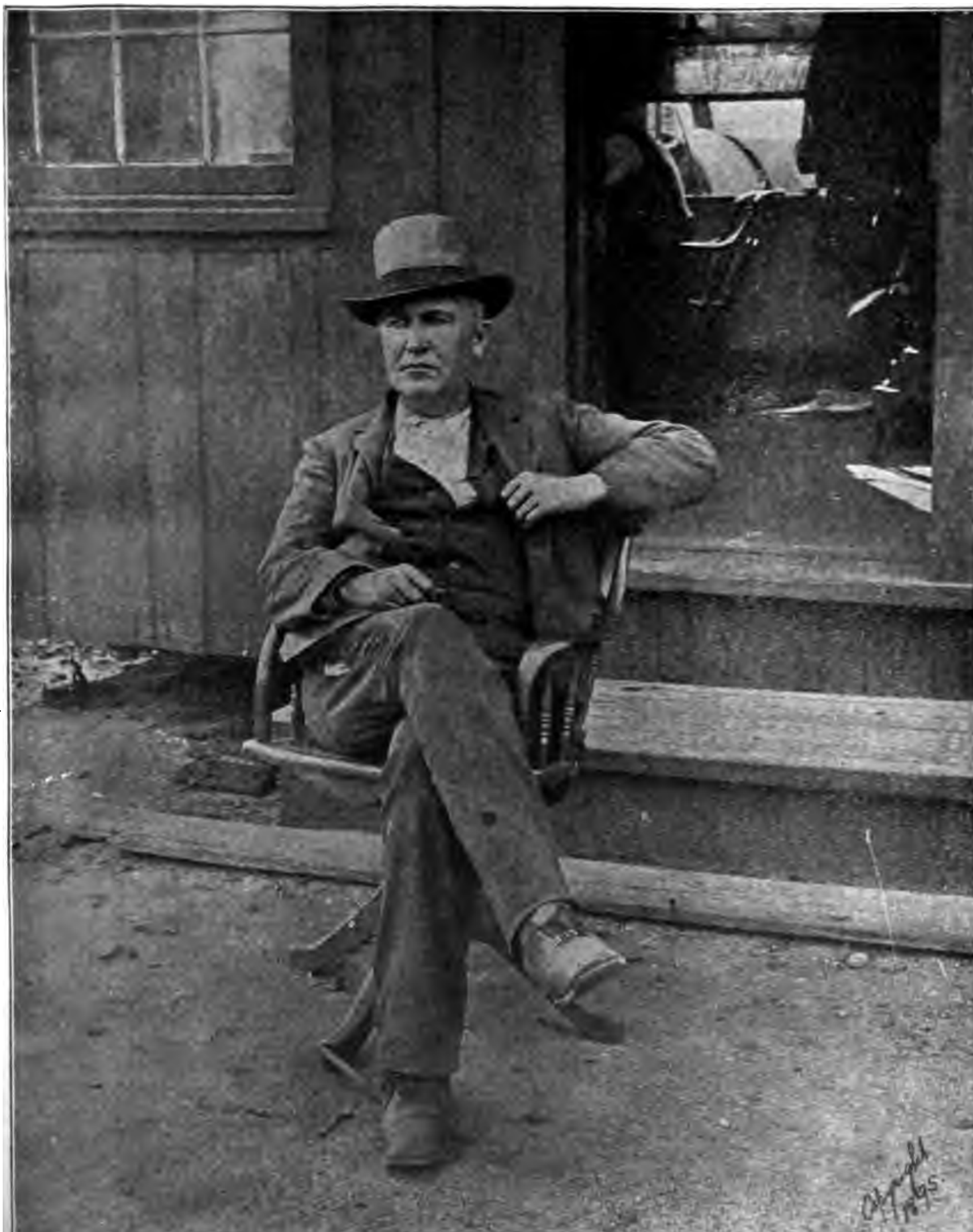
PROGRESS

THE WORLD'S
MPHANT KNOWLEDGE
AND WORKS



THOMAS A. EDISON, THE WORLD'S MOST FAMOUS INVENTOR.

Photographed in front of his office at his Ogden, N. J., iron mines. This picture of Edison in his working clothes is very life-like, and the only one of its kind that has been taken.

OUR

WONDERFUL PROGRESS

THE WORLD'S TRIUMPHANT KNOWLEDGE AND WORKS

A VAST TREASURY AND COMPENDIUM
OF THE ACHIEVEMENTS OF MAN
AND THE WORKS OF NATURE

Pictorial
Literary
Educational

BOOK I
The Industrial Age
A graphic account of the gigantic consolidations and combinations of world-wide influence, and the commercial and mechanical methods of the world's great industries

BOOK II
The World's Science and Invention
Depicting the development and the applications of the great natural forces and principles utilized by mankind

BOOK III
Marvelous Peculiarities and Noteworthy Facts of All Nations and Countries of the World
The most picturesque, interesting and important details of modern life in every land

BOOK IV
Amazing Wonders of Nature
The greatest and most significant among the works of nature, contrasting vividly with the works of man

BOOK V
Things We All Should Know
An array of selected information, popular, technical and statistical, on a multitude of subjects of everyday value and importance

Five
Comprehensive
Books
In One Volume

Embellished and Illumined by Nearly Four Hundred Photographic Illustrations

EDITED BY
TRUMBULL WHITE
AUTHOR, TRAVELER AND GEOGRAPHER, ASSISTED BY A CORPS OF SELECTED SPECIALISTS

To

The Ambitious, the Studious

and the Industrious,

Be They in High or Humble Station,

in Whatever Walk of Life,

This Work is Dedicated.

To Them the World's Progress

Toward Enlightenment

and Happiness

Is Due.

PREFACE

The work here presented is calculated to serve the needs of at least two distinct classes of readers, neither purpose primary, neither purpose secondary, but both kept constantly in mind as standards by which all matter considered for entrance into the pages should be measured. In one aspect it is intended to be a book for the busy reader, the practical reader, the reader in haste, who seeks definite information and facts about the world as it is to-day. In the other aspect it is planned to be a book for the entertainment and instruction of the studious reader, who wishes to understand the processes and progress of modern conditions the world over. It is a book of live subjects, on the achievements of man and the works of nature, so presented as to make it equally adaptable for pleasant reading, ready reference, accurate instruction or careful study.

The educational qualities of the work have been kept prominently in mind from the first planning of it. Never before was there so great a demand for the knowledge which is power. What the world wants is the man who knows. This is the age of universal education. There is no excuse for ignorance to-day. The demand for men of broad mental equipment is never wholly supplied. The positions demanding such men are much more numerous than qualified candidates to fill them. The men whose energy and ambition prompt them to strive patiently for mental improvement in spare hours, are few in number, compared with the vast majority content to stagnate, year after year, in poorly paid subordinate positions. Those who pay court to knowledge by systematic home study, eventually secure the choice places. The field is open, the opportunities were never more numerous. It is believed that the volume in hand is a storehouse of such essential information as will assist the ambitious reader to take advantage of the manifold opportunities, by acquiring the methods of modern progress which lead to prosperity and success.

Here are arrayed those marvelous facts which make modern life and methods supreme in interest and importance. The fairy tales of the past, told to while away an idle hour with mysterious impossibilities, are outdone by the realities of the present. Here the true relations of all phases of human activity are shown, in their bearing upon the affairs of the world of to-day, so that the work becomes, in the highest sense, a book of new, fresh and accurate information.

To make more readily available such a wide variety of matter in a work of such extensive scope, it has been subdivided into five comprehensive books, all contained in a single volume.

Book I.—The Industrial Age.—We are manifestly in the midst of the Industrial Age, when every force of nature and every conception of the mind of mankind are being turned into such channels as will lead to greater industrial power. American enterprise is forging ahead into the world-markets so rapidly as to alarm the rival nations. Embodied here are all the facts of highest importance concerning the great undertakings of to-day, in these lines of activity. The methods, combinations and achievements of the money captains and the captains of industry are made clear. The railway, bank, manufacturing, lumbering, mining, stock-raising, meat-packing, shipping, and other interests which come into contact with all people, are depicted by graphic chapters and artistic illustrations.

In addition, such recent triumphs of inventive genius as are just passing over the line that divides the scientific discovery from the practical industry, are treated with special fullness and care.

Book II.—The World's Science and Invention.—No longer do great men, making triumphant discoveries in the realm of science and invention, have to fight for recognition, as did Galileo of old and many a man of more recent time. Instead, the world is eager to welcome advance in these, as truly as in other directions. The great captains of industry have enlisted with them the masters of science, and the world moves faster in its progress as a result of the powerful alliance. Here are gathered such triumphs of science, invention and discovery as are most significant in their universal interest to-day. The navigation of the air, the development of the automobile, the applications of electricity, the wonderful machinery created by inventive genius and utilized in the great industries, all these and a host of other kindred topics are included, with a multitude of valuable illustrations accompanying the graphic descriptive text.

Book III.—Marvelous Peculiarities and Noteworthy Facts of All Nations and Countries of the World.—In this age no man nor no country can live in absolute independence of all others. The interests of all mankind are so closely interwoven the world over, that what affects conditions in one land has its effect even to the antipodes. So it becomes of the highest importance to be fully informed of our neighbor nations near and far, their peculiarities, their industries, and the facts of interest and significance about them. In this splendid volume the whole world is viewed in the light of modern life and progress, to discover the relations of industry, commerce, natural conditions, history and travel in every land.

Book IV.—Amazing Wonders of Nature.—Contrasting vividly with the industrial and intellectual triumphs of man in the present age of the world, are the eternal works of nature. Here these wonders are depicted by graphic description and artistic illustration. From the glaciers of the Arctic regions to the earthquakes and volcanoes of the Tropics, the most important and interesting subjects are here treated in this limitless field of inquiry. In every instance the newest discoveries in the realm of natural science, bearing on the phenomenal facts of the planet which is our home, are recorded and explained here.

Book V.—Things We All Should Know.—Under this broad classification have been gathered a multitude of subjects and selected information of the utmost value. The list includes such topics as legal facts and forms, medicine and the prolongation of life, civil service, athletic sports, military, religious, commercial, geographical and other statistics, and a mass of general knowledge, both technical and popular, concerning which all need be informed.

To the foregoing array of facts included, must be added a mention of the hundreds of selected photographic illustrations of modern conditions in the industries and the life of the world to-day. Finally, the arrangement of the matter and the comprehensive indexing of the volume are such as to make the whole readily and promptly convenient for immediate reference and use on any subject. With the assurance that by its timeliness and its merit the work will win a wide welcome from the reading public, it is ered for consideration by

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THE PROGRESS AND TENDENCIES OF CIVILIZATION

This is the Industrial Age, the age of triumphant knowledge. Follow the records of mankind down through all the centuries, scrutinize the achievements of the race, and more and more conspicuous becomes the fact that in no other period of the world have such marvelous advances in material and industrial progress been made. Within the last decade we have seen a dozen inventions and discoveries, any one of which would be sufficient to illuminate a whole century of the Middle Ages.

The history of the planet is recorded in the eternal hills themselves, and the mighty phenomena of nature. The history of man is shown in his works. From the days of the cave and cliff dwellers, the days of stone hatchets and bronze tools, the days of primitive life and primitive emotions, we have come to a day when the race is housed and fed and clothed and enlightened as never before, with improvement still a constant tendency. A palace in medieval times did not contain the genuine comforts of a mechanic's home of to-day. A British monarch two centuries ago could not have half the real conveniences or the luxuries at his command that are readily in the possession of any modern American householder. So it is of high interest to examine the tendencies of to-day, to discover the drift of society and industry, to observe the sources and the methods of the amazing activities that are enthroned in our high places.

We are taught by the records of man and nature that in the beginnings of the race, individualism ruled. Every man's hand was for himself and against all others. Food, shelter and safety from attack were the only demands made by primitive man, and for those things he strove. Out of individualism developed the first forms of social organization, stimulated by the discovery that in union was strength. In other words, man could better provide food, shelter and defense by joining with his neighbors than by opposing them. The growth of society from this nucleus was logical and natural. The history of civilization is one of the most interesting and important subjects for the attention of students, but even a summary is forbidden here by the limitation of space. Through individualism, primitive society, and organized competition, we have reached the conditions now in effect.

The conspicuous tendency ruling to-day is the consolidation of enormous commercial, industrial, and financial powers, into what we characterize as "monopolies," "syndicates," and "trusts." But even the trust itself, in its most extreme form, is merely a natural outgrowth of conditions long developing. There is no essential difference in principle between the great department store of the metropolis and the general store of the country crossroads. Size is the only vital distinction. The village banker embodies all the characteristics of the money captain of Wall Street, except that of magnitude. The owner of the transfer line which carries passengers and their baggage from railway to hotel is a transportation magnate on a smaller scale. Any man who has goods which another wants, and holds up the price therefor to the limit of his customer's ability and willingness to pay, is illustrating the principles of monopoly. And so it is through all our relations, that the parallels of the monopolies, the syndicates and the trusts may be found, be they small or large.

Broadly speaking, any form of organization which economizes labor and produces a given result with the least demands upon man and material, is good. The surplus thus released becomes available for other service, and the general tendency is toward a broadening of industry and opportunity. This is not less true because in many instances the process of readjustment is a painful one, bringing hardship to individuals or classes. Nor is it controverted by the fact that monopolies and their kin are sometimes oppressive, claiming for themselves all the benefits of economized labor and material that should accrue to the public they serve.

It is beyond question that the telegraph service of the country is more adequate and efficient, to the advantage of every patron, consolidated as it is, than if it were scattered among a score or a hundred small companies, each confined to a certain district, or all competing for trade in every community. And yet it may be retorted with some reason that it is just as truly an extravagance of labor and equipment for three milk wagons to traverse a given neighborhood at the same time every day, each serving one-third of the householders, when one could do it just as well, thus leaving the surplus men, wagons and horses to some employment actually productive. If closely parallel lines of railway, each requiring to earn interest and profits, are an improper drain on the country they traverse, where one would serve all purposes equally well, in less degree the same is true of parallel routes for the milk wagons. It is a long line of query thus opened up.

Inventions have had to face opposition throughout the whole history of the world, even until to-day. The self-binding reaper was one of the triumphs of modern invention in the mechanical field, but it was riotously assailed as revolutionary and disastrous to industry by mobs of agricultural laborers who saw their occupation vanishing. Yet the broad prairies of the Mississippi valley have been brought under cultivation, and homes and employment have been created for millions, by the improvement in agricultural machinery. The typesetting machine was opposed because one would do the work of several hand compositors, and many men would be discharged, but newspapers have multiplied and enlarged by its introduction, and the whole craft has ultimately benefited thereby.

Let the reader meditate on these conditions, thus briefly suggested, and reason out for himself the lessons of the fundamental principles involved. We are living in the Industrial Age, with all that is signified by the phrase, an age in which expansion and consolidation go hand in hand. The amazing progress of invention and discovery helps to make more rapid the development of the dominant tendencies. Great movements become conspicuous, and drawing attention as they do, they are the objects of scrutiny to discover wherein things may be made better. Already the trusts are the subject of controversy as to whether they are good or bad. Their friends declare that they serve the public better than it has been served before. Their enemies declare that the trust powers reserve for their own profit all the benefits that should be general. One radical may demand the disintegration of the trusts; another may see in them organizations which could be taken into public ownership with the utmost ease. Some thoughtful men observe evidences of a return toward individualism of a modern type, not the reign of contention such as ruled in the childhood of the race, but something higher and better.

Manual training and true domestic science are having their influence already, and this training is destined to exert a transforming influence in the social and economic life of the people, if the prophecies of students in these great fields are to be accepted. Before the Industrial Art League of Chicago, a famous preacher and sociologist, after speaking of the rapid substitution of electricity for steam-power and the possibility of carrying to an indefinite number of shops and factories the new power—it may be transmitted to a residence and employed for running a sewing machine or a dish-washer—said: "The factory system of to-day will become unnecessary, and into every house power can be brought which will drive each wheel for the artisan in his own little workshop. The masses, which are causing the students of sociology so much study, will disintegrate until they become not independent, but interdependent artisans, artists in their work, who shall have the opportunity to develop the best within them."

There is romance even in statistics when one seeks the lessons behind the figures. It is a startling array of facts which one finds in the bulletin on manufactures issued by the United States Government, out of the census returns of 1900. The total value of manufactured products in the United States during the year 1900 reached the stupendous sum of $13,000,000,000. This was an increase of 39 per cent over 1890.

In 1890, however, there was increase of 74 per cent over 1880; in 1880 an increase of 27 per cent over 1870; in 1870 an increase of 124 per cent over 1860; and in 1860 an increase of 85 per cent over 1850. It will be seen, therefore, that the increase from

1890 to 1900 was not abnormal. When one turns to the individual items which together form the total of manufactured products, one is struck with the fact that the iron and steel industry, though a colossus, is not the only colossus in the country. The value of the iron and steel product in 1900 was $835,000,000. Compare with this the value of the products with which men clothe themselves. Textiles amounted to $966,-000,000; boots and shoes to $261,000,000; a total of $1,227,000,000. Consider also the industries which are concerned with the preparation of food and drink. Slaughtering products amounted to $736,000,000; flouring and grist mill products to $560,000,-000; liquors, vinous, malt, and spirituous, to $340,000,000; cheese, butter and condensed milk to $131,000,000; a total of $1,767,000,000. It appears, then, that in 1900 the consumer took thought of what he should eat and what he should drink and wherewithal he should be clothed, to the extent of just about $3,000,000,000. His demand for iron and steel was not much more than one-fourth that sum.

Perhaps, however, the most interesting deduction that can be made from the bulletin on manufactures is concerned not so much with products themselves as with productivity. The capacity to produce is increasing. If we take the half century from 1850 to 1900, the population has increased about two and a quarter fold. Meanwhile, wage-earners have increased about five and a half fold; wages about ten fold; capital about nineteen fold, and the value of product about thirteen fold. It is evident that the productive capacity of the people of the United States is increasing rapidly with the improvement of machinery and the more extended investment of the capital. It is the conclusion of the chief statistician for manufactures that "the apparent value of products per wage-earner has increased from $1,065 to $2,451 in 1900."

It is these significant facts and others akin to them that justify the characterization that this is the Industrial Age, the age of triumphant knowledge.

HOW CIVILIZATION HAS DEVELOPED

Let us note now, briefly, the history and progress of civilization, illustrating these fundamental principles that have led us to the Industrial Age of to-day.

Civilization has developed to its present high standard through the ability of man to acquire, retain and use knowledge. The brute creation is not perceptibly better qualified mentally at this time than it was when the first records of men were made. The reason is that brutes acquire nothing beyond their instincts except what is within their own experience, received within the narrow bound of their activity and in the small space of time through which they live.

Man classifies, specializes, accumulates, and saves from all parts of the earth and for all time. One person is thus enabled to make use of the achievements of all and all may profit by the labors of every one. Thus civilization has the advantage of the composite mind of the entire human race and such a vast mental force with countless eyes and ears for new things, must by necessity continue to advance.

In other words, civilization is a mental universe consisting of suns, stars, planets and satellites in a process of evolution wherein the fittest survive and the least worthy perish. Civilization is therefore the establishment of social order in the place of individual independence and the lawlessness of barbarous life. It exists in as many degrees as there are communities or nations, and it is susceptible to continuous progress on up to the perfectibility of man. Sometimes the progress is in one direction, then it sways over to another. At various stages it makes different objects the principal aim, and where the preservation is complete it never recedes or retrogrades in its general advance. In time of war, patriotism is the chief virtue; in occasions of distress, charity; in periods of national defeat, humility, and so with people as with individuals, the progress toward perfection is largely emotional, but what is gained is not lost.

Civilization has been defined as the discovery and gratification of human needs; in other words, the multiplication of wants. It is not solely the organization of society, for organization is but the house in which society lives. The whole man is not contained within any organization, for states perish and man endeavors to fit himself for a life beyond it all. There has always been the struggle of ideals as to whether civilization should exalt the people, the church or the state. This has given rise to the many political sects and cults. In every case there has been a leader of great enthusiasm and ability to advance the standard of a given idea, and set it firmly in the forefield of civilization. In general, the term civilization designates the condition and powers of society as to its industrial, ethical and educational well-being.

Far back of the ability of man to make records of his thoughts or achievements the mutual dependence of man made it necessary for him to form social communities either to ward off the encroachments of enemies or to satisfy the ambition of some primitive warrior or statesman. The social community began with the Jews in prehistoric times with the family and its patriarch. Likewise in Scotland the original neucleus of civilization was the clan with its chief

Buckle in his "History of Civilization" sets forth the following principles as governing the development of civilization:

1. Free-will rests on the erroneous belief in the infallibility of consciousness, since statistics prove that human actions, development and progress are governed by laws as fixed and regular as those which rule in the physical world.

2. The favorable relation of climate, soil, food, and the aspects of nature, are the

principal causes of intellectual progress, in which man may become stronger than nature and manipulate it to his own advantage.

3. Moral agencies everywhere sum up about an average and are very stationary, while intellectual activity is varying, advancing and of perpetual accumulating power.

4. The value of intellectual advancement depends upon its being grounded in the common morality, therefore religion, literature and government are not the causes, but the expression of civilization.

5. Civilization advances with the disposition to doubt and to investigate.

Laurent and other writers, especially the theologians, hold that the advancement of civilization is the result of the direct influence of a Supreme and Infinite Intelligence.

Guizot, one of the greatest of writers, presents no material or theological theory, but attributes the growth of civilization to the nature of individual and social development through the accumulating of useful material, as the tree might develop could it study and provide for its own wants. The greatest factors in the line of progress he believes to be the church, the crusades, the feudal system, the free cities, growth of monarchies and the reformation. In material things, the invention of gunpowder, of printing and of the uses of steam have made possible otherwise unthought of achievements.

Only in movement has there been progress. Such nations as India, Egypt and China have kept to the past, unchangeable, while the turmoil and struggles of the West developed the nations to their highest capabilities. No one can read ancient history without being struck with the strange progress and ruins of nations from migrations and conquests. The Scythians flow into southern and western Asia like a great flood, overcoming everything in their way, and long after that the Turks almost succeed in doing the same thing for Europe. Greece, Rome, Spain and France take turns in the conquest of the world. The discovery, exploration and colonization of unknown portions of the earth, the greed for gold, the rise of great cities, the creation of great manufactories by invention, the consequent incentive to industry and commerce, are all in the line of development that lead up to our present systems of order and law.

With the rise and establishment of modern nations on their present basis of national organization came security in personal achievements and possessions, and in this the individual found his self improvement and the people their present advancement.

THE ORDER OF SOCIAL EVOLUTION

Here then is the order of evolution: First the simple, next the complex, finally a return to the simple. Never a backward step is this last; merely a correction of the errors of the primary state, which was in principle right, but in many of its methods wrong. Having in mind this orderly procession of development, and considering existing conditions, we recognize the present as the moment of the greatest and most complex organization in the world's history. The trust is, indeed, the natural evolutionary product of the capitalistic side, and the trade union, forced into existence to meet it, is the natural result also of conditions in the labor world. Both are top-heavy, both in the ultimate are menacing to the world's peace and prosperity, both aim to destroy individual initiative and personal liberty and responsibility. In the nature of things this condition of things will not long endure. That the change will come quickly, however, is not possible. Just as the development of the trust and union have been step by step, one thing leading to another, and covering a long period of time, so will be their disintegration, and the development of that fine individual life which shall make for a more social life, be brought about step by step. The hopeful fact is that it is coming as surely as the sun will shine on the morrow, and through laws as immutable as those which govern the movements of the spheres and compel the sun to give to the earth its light and warmth. Such a thought and an abiding faith in its ultimate materialization must give new hope and courage to the world.

And if we turn to the farm, we find this condition already largely in existence. It cannot work out perfectly there, of course, so long as we are so far from its realization in other directions; for man liveth not to himself alone, but is bound up in the social bundle in such a way as to make it impossible for him to extricate himself. And it is a wise providence that this is so. Yet the farmer more nearly typifies the ideal here presented, than any other calling to-day. Let him not surrender one jot or tittle of his splendid heritage of independence. Let him not be lured by the false lights of wealth quickly acquired, to leave his farm home for the glittering bauble of city life and city loss and decadence. The independent man to-day, that is, the man of largest independence, is the farmer who finds his living on the farm and his profits in whatever surplus products he may raise. With the telephone, with the extension of the electric railway, with the better local school and the agricultural college, with all these beneficent aids reaching out to him, the social life of the farmer is becoming year by year more ideal. He is to-day the dividing line between the old and the new, between the simple and the complex in the economic world. The least disturbed by the tremendous changes involved in the trustification of business, he also will fall the most naturally into the new order when we return once more to the path which makes the strong individual and leads to a purer society. How great a factor he may be in the world's uplift depends wholly upon the manner in which he shall employ his transcendent opportunities.

Great inventions and discoveries mark the real epochs of civilization far more truly than do the wars of the nations or the reigns of powerful monarchs. Marshalled here in chronological order are indicated the greatest of these noteworthy achievements of human genius and energy, a significant array of evidence of the progress of man from the days of the childhood of the race to this Industrial Age of to-day.

GREATEST DISCOVERIES AND INVENTIONS

Alphabet of letters attributed to the Phœnicians.

Iron anchors originated with the Greeks.

Manufacture of glass by Phœnicians and Chinese.

Second Century—First European manufacturing of glass in Normandy.

Third Century—Specific gravity by Archimedes.

Seventh Century—Sun dial by Anaximander.

Twelfth Century—The compass by an Italian. Used centuries before by Chinese.

1320—Gunpowder by Schwarz. A crude form used in 1280 by the Moors and long before by the Chinese.

1422—Printing by Lawrence Coster.

1438—Metal types by Gutenberg.

1543—Copernican System of Astronomy, the basis of present astronomical knowledge.

1590—The microscope by Janssen.

1608—Telescope by Lipperscheim.

1616—Circulation of blood by Harvey.

1640—Bayonets by Puseygur.

1643—Barometer by Torricelli.

1651—Electricity discovered and named by Dr. Gilbert.

1682—Laws of gravitation by Newton.

1705—Steam engine by Newcomen.

1720—Pianoforte by Cristofori.

1720—Thermometer by Fahrenheit.

1762—Chronometer by Harrison.

1767—Spinning jenny by Hargreaves.

1783—Balloon by the Montgolfier brothers.

1785—Weaving loom by Cartwright.

1785—Life boat by Lukin.

1793—Cotton gin by Whitney.

1796—Vaccination by Jenner.

1796—Lithography by Senefelder.

1807—Steamboat by Fulton.

1814—Locomotive by Stephenson.
1816—Safety lamp by Davy.
1817—Velocipede by Von Drais.
1824—Spectroscope by Kirchoff.
1828—Photography by Niepce.
1833—Guncotton by Bracounot.
1835—Telegraph by Morse.
1837—Phonography or "shorthand" by Isaac Pitman.
1840—Penny postage established by Sir Rowland Hill.
1841—Sewing machine by Elias Howe.
1847—Cylinder printing press by Richard Hoe.
1848—Chloroform by Simpson.
1858—Evolution by Charles Darwin.
1859—Bessemer steel by Bessemer.
1867—Typewriter by Sholes and Glidden.
1876—Telephone by Bell.
1878—Phonograph by Edison.
1879—Electric light by Edison.
1898—Liquid air by Tripler.
1899—Wireless telegraphy by Marconi.

THE WORLD AS IT IS TO-DAY

So much for the past. Now let us look at the present. In the volume presented herewith, it has been planned to put in the possession of the reader such an array of facts and information of genuinely educational character as would enable him to observe clearly the greatness of this industrial age and its tendencies. The methods and results of the great industrial and commercial undertakings of the world; the modern world of invention, discovery and scientific enlightenment; the more noteworthy works of nature which bear upon man and his achievements; the nations of the earth and the most conspicuous facts about them at the present moment, and a mass of matter concerning the things we need to know in every channel of human activity and interest—these are the general contents of the volume in hand.

The work is not a history, though it contains much of historical enlightenment. It is not an encyclopedia, though it contains an encyclopedic volume of information. Instead of these it is a book of the world to-day, of the Industrial Age, for reading, for reference, for education and for study. In it the mass of material has been so arranged by a natural classification as to be readily at hand for convenient use for any purpose. Under the general heading of The Industrial Age are included accounts of the great commercial, manufacturing, industrial and financial undertakings which have risen so rapidly of late years. Their interesting phases are explained and pictured and the great cities of the world contribute to these pages.

The triumphs of modern science, invention and discovery are grouped in startling array, an evidence of the capacity of the human mind to encompass almost any achievement that genius suggests.

The world at large is moving with the spirit of this same Industrial Age. Its international relations are shifting, thanks to the influence of new political, military, and industrial conditions. Such facts are noted here about the peoples of the earth and the nations which they have established, as seem in each case most interesting to the reader or throwing light upon their present conditions and significant of their general characteristics. Sometimes this is a historical fact, sometimes commercial, sometimes personal. The very variety adds interest to the pages.

The works of nature, which outvie all the deeds of man, are an exhaustless field of inquiry and interest. Here such are selected as are commanding in their importance and of immediate interest at the present day for some special reason that brings them into prominence.

Finally, as a source of varied information of general scope, are included the multitude of subjects under the comprehensive heading, "Things we all should know," a treasury of facts sufficient to fill a whole volume, if in more expanded form.

With the assurance that this work will command and justify attention by its plan and execution, placing readily at hand as it does the information for which everyone is seeking in regard to the world, its conditions and its activities to-day, it is presented herewith to the reader.

Educational it is believed to be in the highest sense, in the real significance of the word. Going back to its derivation, to educate means not merely to present certain facts or to place a mass of knowledge at the command of the individual, but it means to lead him outward into the wider range of thought, to develop his mentality, to put in his possession a larger body of significant truths from which he shall be able to reason and deduce for himself the lessons and the tendencies of life. And so the information here compiled is intended to be of educational value to any thinking man.

It is unnecessary to suggest that in a work of such magnitude the editor has had recourse to extremely varied sources of information. Based on the fundamental purpose of having its facts brought up to the very latest possible moment, they had to be sought far and wide, sometimes in places little accessible to the usual reader. Encyclopedic as the work is in many features and characteristics, it is not from the encyclopedias that its matter could be culled. Those ponderous and valuable works are necessarily years behind their publishers' dates in the contents of the volumes, and except in the unchangeable things of the world—and there do not appear to be many such nowadays—they must be supplemented by later information at the very time they are issued, if the reader is not to be led astray.

With the desire to occupy a field created for itself, and therefore peculiarly its own, the present work has kept timeliness in the foreground, and its pages are absolutely "up to date." The daily newspaper is the only printed matter against which a time comparison is never to be challenged.

Whatever measure of success has been achieved in the effort to produce a worthy work must be credited in common to the liberal scope on which it was planned by the publishers, the able editorial and literary assistance rendered by the specialists who shared in the writing and compilation of it, and the generosity invariably shown by all who were approached in the search for information or photographs which were needed to assist the undertaking. It is a pleasure, no less than an obligation, to acknowledge these essential aids with the utmost cordiality. Rarely, if ever, has such a noteworthy collection of views of the world's industries and industrial processes been gathered within a single volume, and the series of illustrations in the other divisions of the work are no less striking in their variety and the freshness of the subjects chosen. Energy and liberality on the part of the publishers and courteous co-operation on the part of many from whom rare and valuable photographs had to be obtained after considerable difficulty and expense, united to make such elaborate illustration possible.

In like manner the search for new and interesting facts, which, indeed, had to precede the quest for illustrations, met a hearty response from the men who know things and the men who do things all over the world. Most of the facts herein contained have been gathered at first hand from the original sources of information, by travel, by research or by interview, and from such sources may be accepted as accurate within the limitations of human imperfection. Where books or other printed matter contained facts that would serve in this connection they have been levied upon appreciatively for a share of their learning, adapted and modified to suit the present purposes. Such writings are properly included in the foregoing acknowledgments.

Now that the work is completed, it remains but to place it before the reader, with the desire that it may serve him well in the manner planned. That this desire may be realized is the earnest hope of THE EDITOR.

GUGLIELMO MARCONI.

THE GENIUS WHO DEVELOPED WIRELESS TELEGRAPHY.

Marconi was born at Marzabotto, Italy, on April 17, 1875. From his Italian father, who was a land owner, he gets his name, Guglielmo, which he prefers to William, its English equivalent. His mother, however, was of Irish birth, and he speaks English as perfectly as he does Italian. Indeed, he has quite the appearance of an Englishman, and for a considerable part of his life his associations have been English.

Marconi was educated in Italian universities. He had not reached his majority when the idea of telegraphy without wires began to interest him, and he decided upon it as his special field of labor. His father's backing for the necessary outlay enabled him to carry on his experiments, and by April, 1899, he was ready to startle the world by sending messages across the English Channel. In October of the same year, the young scientist came to America to report the international yacht races between the Columbia and the Shamrock for the New York papers, and messages were flashed across space when both yachts and sending ship were enveloped in fogs and out of sight of land. By this time the inventor has taken out 132 patents in every civilized country of the world, which indicates in some degree the manifold details which he has had to consider in perfecting his appliances.

BOOK I

THE INDUSTRIAL AGE

WIRELESS TELEGRAPHY, A TRIUMPH OF MODERN DISCOVERY.

Today the traveler on a transatlantic steamship, far out in midocean, can write a message to his friends at home, hand it to an operator who sits at the side of a simple instrument in a cabin of the vessel, and for a few cents a word it will be transmitted across the intervening space, over the stormy sea, to a receiving station on shore, and thence by land telegraph wires to its destination, all with the speed of electricity.

GUGLIELMO MARCONI IN WORKING CLOTHES.

It is only forty-three years since the announcement was made to an incredulous world that the Atlantic cable was a success and that telegraphic messages could be sent under the ocean from America to Europe. Many people remember the enthusiasm with which this amazing achievement was greeted, when the conviction was established that it was really true. Today the world is still enjoying the results of new scientific discoveries that are constantly being made, and the ones that seemed most marvelous when they were first announced, become commonplace after a few years have passed. Most conspicuous of all the recent discoveries in science, and farthest reaching in its possible ultimate effect upon our material affairs, is the successful system of wireless telegraphy, developed and established by the genius of the young inventor, Marconi. It was a triumph when his experiments resulted in communication at will without wires over distances of 250 miles. But hardly had the public become accustomed to this fact, when the announcement was made upon the authority of the young inventor himself, verified by unmistakable evidence, that on December 12, 1901, he had received signals across the Atlantic by this same system of wireless telegraphy. Wonderful as it was, the world has become so accustomed of late years to scientific discoveries which, but a short time ago, would have seemed extravagant and impossible claims, that this announcement was promptly received as an accepted fact, incredulity existing hardly anywhere. The interested public had long before learned that Mr. Marconi's announcements were never made until he was sure of his facts, and consequently people did not need to be reassured when this greatest wonder of all was announced. It was a red letter day in the history of scientific progress, that winter day in Newfoundland, and yet it was the direct result of a logical, persistent and patient effort on the part of Marconi, the result of years of preparation, study, and experimentation, leading directly to the goal of his ambition.

MARCONI AT HIS RECEIVING INSTRUMENT.

Let us examine the process by which messages are thus transmitted through space without the aid of connecting wires through which they may pass. Those of us unfamiliar with electrical apparatus are accustomed to consider only such electrical streams as take their way along wires. But there are a great many other electric streams unconfined by wires, which can be quite as telegraphic as if they kept to paths of copper and steel. Discoveries suggesting this fact were made as long ago as 1842, and others looking in the same direction have followed. Marconi makes no claim to being the first to experiment along the lines which led to wireless telegraphy, or the first to signal for short distances without wires. But in spite of his prompt acknowledgment to other workers in his field it has remained for Marconi to perfect a commercial system and put it into practical working order over great distances.

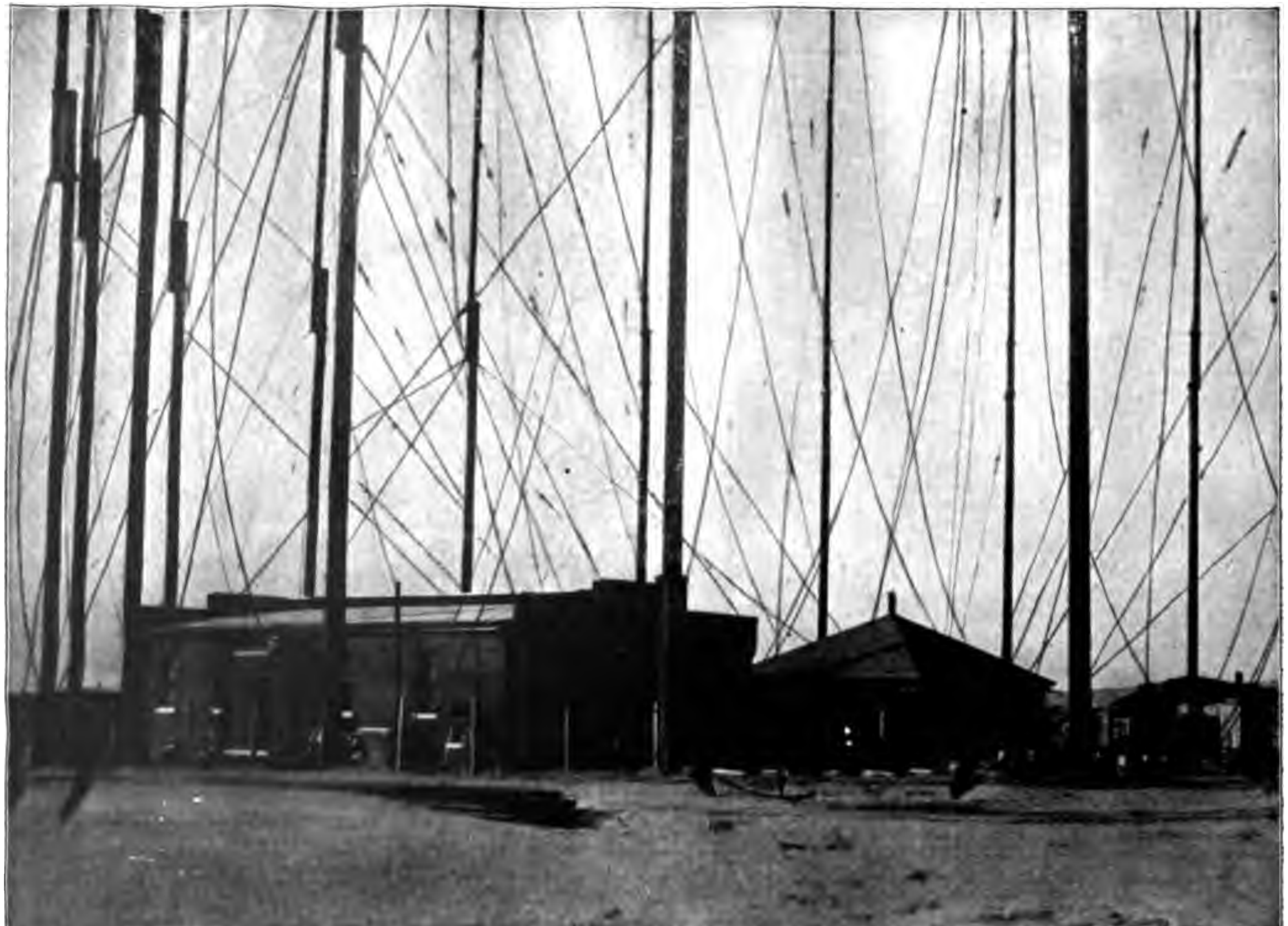
The two first essentials in wireless telegraphy, as Marconi has developed it, are the vertical wire, which he suspends in the open air to catch his messages, and the "coherer," which by its exquisite sensitiveness makes it possible to register the messages as received. Electrical waves cannot be seen, but electricians have learned how to incite them, to a certain extent how to control them, and have devised cunning instruments which register their presence. These waves have long been utilized for sending messages through wires. Marconi started with the assumption that inasmuch as electrical waves may pass through the ether which fills all space as readily as through wires, if these waves could be controlled they would evidently convey messages as easily as the wires. So he had to make an instrument which would produce a peculiar kind of wave, and another apparatus which would receive and register this wave at a distance from the first.

The transmitter which resulted from his experiments is an apparatus from which a current generated by a battery and passing in brilliant sparks between the two brass balls is radiated from a wire suspended on

MARCONI'S ASSISTANTS PREPARING TO RAISE THE KITE WHICH SUPPORTED THE RECEIVING WIRE.
(Marconi, approaching from the left, indicated by an X.)

a tall pole. By shutting off and turning on this peculiar current the waves are so divided as to represent dots and dashes, and spell out letters in the ordinary Morse alphabet of telegraphy. The waves which come from the transmitter are received on a suspended wire, elevated either by a mast, a kite, or a balloon. This wire is exactly similar to the one used in the transmitter, but by the time the waves have passed over a long distance they are so weak that they could not, of themselves, operate an ordinary telegraphic system. It is here that Marconi utilizes the coherer as the final essential in the invention.

The coherer is a little tube of glass, about two inches long and as large as a small lead pencil in diameter. It is plugged at each end with silver, the plugs nearly meeting within the tube. The plugs are separated by a small quantity of nickel and silver filings, finely powdered. Under ordinary circumstances the filings are jumbled together like the particles of a sand heap, and in that state they form a poor conductor. The moment, however, that they receive an electrical wave they cling together tightly as a solid conducting bridge,



MARCONI WIRELESS TELEGRAPH STATION.

At such stations on the Atlantic coast, one of which is at Poldhu, Cornwall, the southwestern extremity of England, one in Nova Scotia, and one at Cape Cod, Massachusetts, the messages are received and transmitted and the experiments carried on. The masts are 210 feet high, and twenty of them are used in a fully-equipped station.

that carries a current from a local battery to a receiving telephone or a telegraphic sounder of common pattern. If it is connected at one end with the suspended wire, and at the other end with the Morse instrument, there is a dot or a dash printed, according to the signal that has been sent by the transmitter, miles away. Then a little tapper, actuated by the same current, strikes against the coherer, and the particles of metal are jarred apart, or decohered, becoming instantly a poor conductor, and thus stopping the strong current from the home battery. Another wave comes through space, down the suspended wire, into the coherer, there drawing the particles again together, and another dot or dash is printed. All these processes are continued rapidly until a complete message is picked out on the tape.

In these early experiments Marconi believed that great distances could not be obtained without very high masts and long suspended wires, the greater the distance the taller the mast, on the theory that the waves were hindered by the curvature of the earth. But his later theory, substantiated by his experiments in Newfoundland, is that the waves follow around the earth, conforming to its curve, and it is not necessary, therefore, to erect masts to a great height. In the experiments of December, 1901, the transmitting station in England was fitted with twenty masts 210 feet high, each with its suspended wire, though not all of them were used. A current of electricity sufficient to operate 300 incandescent lamps was used.

Marconi landed at St. Johns, Newfoundland, December 6, 1901, ostensibly to communicate with the Cunard liners, traversing the North Atlantic Ocean, just along the

CABOT MEMORIAL TOWER.
Loaned by Newfoundland Government for Marconi's experiments.

Grand Banks. The dangers of the Newfoundland coast in the vicinity of Cape Race are well known to mariners, and it was supposed that his motive was to safeguard that coastline so that ships might be located when well at sea and kept in touch with as they approached there, thus reducing to a minimum the dangers of disasters. The Cunard vessels, like nearly all other Atlantic liners, are fitted with his apparatus.

Marconi brought with him an apparatus for the receiving of messages, but not for the sending of them, so no specially important experiments were expected by those not in his confidence. For elevating his long receiving wire he brought a balloon and some kites, which, with his other apparatus, he removed to Signal Hill to begin work. The Newfoundland Government placed at his disposal the Cabot Memorial Tower, recently erected on Signal Hill, where his appliances were immediately stored.

On Wednesday, December 11, he sent up his balloon, only to see it break away and sail off toward Labrador. The rest of his experiments were performed with wires hanging from kites, these kites being about nine feet square, and possessing a considerable lifting power. They were built of bamboo and silk, after the Baden-Powell model. By the time he had lost his fourteen-foot hydrogen balloon and one of the kites the wind died down sufficiently to permit a test, even though not under the most favorable conditions. Thursday, the 12th, was a blustery day, and it required the combined strength of the inventor and his assistants to hold the kite at the elevation of 400 feet, which was desired.

Before leaving England Marconi had given instructions to his assistants there for the transmission of a certain signal at a fixed time each day, beginning as soon as they received word that everything in St. John's was ready. The transmitting station was at Poldhu, Cornwall, the southwestern tip of England. Marconi cabled his assistants when to begin sending signals, and on that bleak winter's day, on the barren summit of Signal Hill, were received the distinct signals across the 1,800 miles of the great Atlantic. Again the next day the signals were repeated, and the experiment was an assured success. The storminess of the day and the consequent impossibility of maintaining the kite at a fixed elevation were handicaps difficult to overcome with the incomplete apparatus at hand. Nevertheless, there was no room for doubt that a signal had been actually transmitted from England to America without wires.

The reception which this wonderful achievement won, when after two days of self-restraint Marconi announced the fact, was memorable. The world wondered and awaited details. Edison accepted the fact as soon as Marconi issued a signed statement. The governor of Newfoundland reported the achievement at once to King Edward, and, most significant of all, the Atlantic Cable Company, which possessed a special charter and exclusive rights for telegraphic service in Newfoundland, demanded the cessation of experiments as an infringement upon its rights, a demand to which Marconi and the Newfoundland Government had to bow. After that the inventor made two or three journeys back and forth across the Atlantic to direct experiments and commercial negotiations, and a station for his transatlantic service was decided upon, to be located near Sydney, Cape Breton Island, Nova Scotia. Newfoundland thus lost for a time the distinction of being the scene of Marconi's further experiments. In addition to this receiving station there is a large one at Cape Cod, on the Massachusetts coast, and these two, with the Lizard station in Cornwall, will complete a triangular service conveniently located for commercial use in the transatlantic system.

Shortly after the transmission of these first signals from Cornwall to Newfoundland came the news of the transmission of entire messages for a distance of 1,551 miles. Marconi was crossing the Atlantic on the steamship Philadelphia, and he exchanged messages with his assistants on land for that distance. The officers of the vessel signed and certified the messages as they were received, and the last remnant of incredulity was banished. The messages were clearly registered on the tape, and inasmuch as the receiver of the Philadelphia was not specially constructed for long distance work the achievement was considered all the greater.

Marconi's faith in his invention is boundless. He modestly but firmly maintains that what he has done is nothing with what he hopes to accomplish in the future. When the world throbbed with the surprise of his exploit, and the cables were loaded with congratulatory messages, he manifested no elation, but calmly declared that he never doubted his ability to employ the magnetic waves across the Atlantic. "When I am able," said he, "to send a message from Cornwall to New Zealand across the Isthmus of Panama, the only land that intervenes, then I shall count that I have accomplished something. The force I shall generate shall be sufficient to send the signals the whole way. And there is an even more difficult proposition which I intend to tackle, more difficult because it involves transmission over land, with all the diversities of the different countries. I shall not rest until I have inaugurated wireless telegraphy between London and Calcutta, overland."

The imagination is overwhelmed in the effort to look forward to the possibilities of a perfected wireless telegraphy system. The $400,000,000 invested in cable systems in various parts of the world would in large measure be lost. The cost of messages would be much reduced by this system. An Atlantic cable costs between $3,000,000 and $4,000,000, while wireless telegraphy stations can be built and equipped on both sides of the Atlantic for less than $150,-

SIGNAL HILL, ST. JOHN'S HARBOR, NEWFOUNDLAND.
Showing the Cabot Memorial Tower from which Marconi conducted his experiments.

000, with a very small charge for maintenance. With all vessels and lighthouses equipped with apparatus, it should be possible to avert collisions at sea and wrecks on shore. In times of warfare generals may signal over the heads of the enemy where they could not possibly string telegraph wires or send couriers. The steamships in midocean would be in touch with the news of the day. It is little wonder that Lloyds, the chief marine exchange of the world, has contracted for fourteen years' use of the Marconi patents.

A general impression prevails that wireless telegraphy is still largely in the uncertain experimental stage, but as a matter of fact it is actually in wide commercial use. Most of the ships of the great navies of Europe, and all the important ocean liners, are now fitted with the wireless instruments. It is being used on many light ships, and the New York Herald receives daily reports from vessels at sea, communicating from a ship station off Nantucket. Though it is not generally known, messages are now received in England at the rate of 12½ cents a word for transmission to vessels that have already sailed from port.

The one remaining element of doubt which has been suggested as to the practical uses of a world-wide system is dismissed by Marconi with the assurance that he already has proved that he can overcome it. This is the question of whether or not messages can be clandestinely read by those for whom they are intended; in other words, if privacy can be assured by a system in which the signals radiate with equal force in every direction from the point of transmission. Marconi has found that he can so harmonize the transmitters and receivers or "tune" them, so to speak, so that they will respond to their own mates but not to others. By this system all the ships of a fleet can be provided with instruments tuned alike, so that they may communicate freely with each other without danger of the messages being read by the enemy. Great telegraph companies would have their instruments tuned to receive their own messages and no others. In one of Marconi's English experiments he had two receivers connected with the same wire, and tuned to different transmitters. Two messages were sent, one in English and one in French. Both were received at the same time, on the same wire, but one receiver rolled off its message in English, the other in French, without the least interruption.

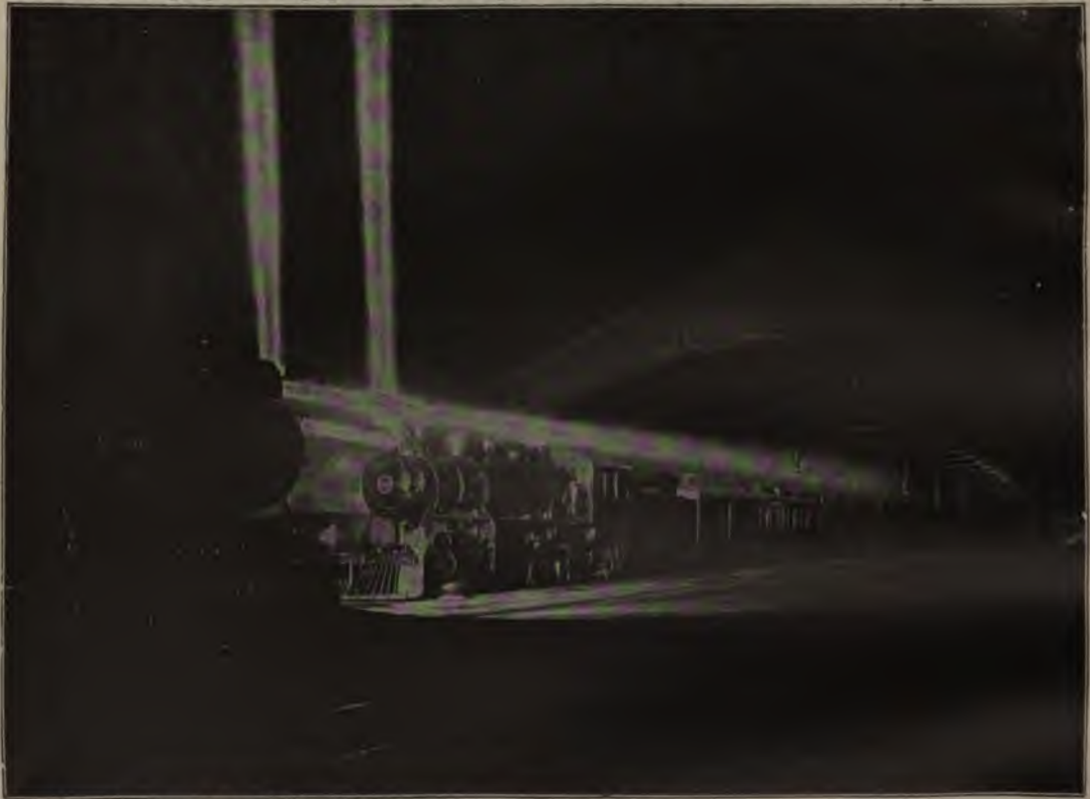
With the progress of science as rapid as it is in these years at the beginning of the century one should be prepared for anything, however startling. Impossibility is a word to be avoided. Already wireless telephone systems are contemplated as a natural development to follow the wireless telegraph, and even these are hardly more wonderful than the phonograph with its manifold developments, the sending of pictures by telegraph, the moving picture machine under its various names, and a host of other scientific marvels which might be mentioned. Incredulity is no longer a safe frame of mind, and after the achievements of Marconi still less will we feel inclined to disbelieve any statement of invention or discovery.

THE WORLD'S GREATEST INDUSTRY

THE RAILWAY

The combined length of the railways of the United States amounts to nearly 200,000 miles, and of the whole world to approximately 500,000 miles. The increase is at the rate of about 10,000 miles a year the world over. If the actual cost of construction and equipment, the production of the materials out of which the lines are built, the employees engaged in railway operation, and the interests which depend for their prosperity on the railway are considered, it may be safely said that the railway is the greatest industrial factor in the world today.

The most able financial organizations, the most skillful executives, and the most ingenious inventors, are devoting their attention to the construction, operation and



SPECIAL TRAIN H. R. H. PRINCE HENRY OF PRUSSIA IN CHICAGO MILWAUKEE & ST. PAUL RAILWAY STATION AT MILWAUKEE, MARCH 4, 1902.

(Photo taken at 9 p. m. by the light of the searchlight headlights. This is the latest device for averting collisions, as the piercing rays can be seen for many miles along the track and flashing against the sky.)

Carrying night lanterns to the top of a railway signal post.

perfection of railway systems. Improvement in the modern railways over those of only a few years ago is conspicuous. Old roads are reconstructing their lines and new ones build with the utmost care to assure the permanency of their tracks, the economy of their administration and the comfort of their travelers. Heavy steel rails have supplanted the light ones of iron; rock ballast is used where earth formerly sufficed; steel bridges span streams and the old wooden culverts are burned at the roadside; curves are straightened, grades are reduced, tunnels penetrate the mountains where trains formerly surmounted the summit by slow climbing. All this contributes to the safety, ease and speed of the journey, but it likewise reduces the cost of maintenance and operation, so that the railway companies find direct as well as indirect profit from their increasing expenditures. The elevation of tracks through cities, thus eliminating grade crossings, and the perfection of various block signals and safety switch systems, help to give additional safety to traffic and make high speed possible.

THE TRACK WALKER.

Rails, ties, switches and signals must be watched carefully to guard against accidents, and such patrol duty is one of the most important functions in railway service.

Train equipment has improved with the increase in travel, and today the railway journey may offer comforts and luxuries at a moderate price, which are hardly to be found in any but the homes of the wealthiest. A modern transcontinental train is in fact a luxurious home, with all the details of a splendid clubhouse or hotel available, while one races across plains and mountains at high speed. Such trains, equipped with palace sleeping cars, dining cars, drawing room and observation cars, a library, barber shop, café, card room, music room, electric lights, and vestibules excluding the noise and dust as one passes from one car to another, with waiters, porters and a lady's maid ready to serve the passengers with everything demanded, add enticement to the prospect of a journey, where formerly the destination itself was the only reward.

It is not alone in the United States that railway construction is advancing rapidly and luxurious facilities for travel are provided. All over the world the same spirit of energy rules and the effort to connect remote lands by these arteries of commerce never ceases. On our own continent, our neighbors to the north and the south are active. One transcontinental line crosses Canada, a second is advancing rapidly, and a railway to Hudson's Bay promises completion within a few years. The Mexican Republic has seen the construction of nearly 10,000 miles of railway within the last few years, and the country is traversed in every direction by lines which are extending rapidly.


ALL ABOARD!

Surveys have been completed for an intercontinental railway, to connect North and South America by way of the Isthmus of Panama. In South America the Andes Range has been a difficult obstacle for transcontinental lines to overcome, but already the mountains have been


SOLID COMFORT IN THE LIBRARY CAR.

penetrated from the Pacific coast by several lines, and a railway from ocean to ocean is a thing of the near future. The heart of the continent is penetrated by numerous lines in Argentine and Brazil, lines which afford an outlet for the immense production of the interior, and novel journeys for the inquiring traveler.

OPERATOR IN THE SIGNAL TOWER.
(Showing mechanism by which switches and signals are controlled.)

In Asia the whole political and military situation has been affected by the construction of the Trans-Siberian railway, built by the Russian Government. Extending all the way from the European provinces of the empire as it does, across the whole of Asia, to a terminus on the Pacific Ocean, it provides a speedy route by which armies may be shifted to any scene of threatened difficulty at the will of the Emperor. Except for its course across Northern Manchuria, in order to obtain a shorter route to the sea, the entire line is within the dominions of Russia, and Manchuria itself is so entirely dominated by Russian authority as to be virtually at the disposal of the railway.

On the Pacific the Siberian Railway and this connecting line, the Chinese Eastern Railway, have one terminus at Vladivostok and another at Port Arthur. The former is a Russian city, with an impregnable harbor on the coast north of Korea. Port Arthur was acquired by negotiations with the Chinese, and situated as it is at the gateway by which Peking must be approached, it becomes a sentinel port whence the Russians can watch their own interests. The entire length of this wonderful railway from the Ural Mountains to the Pacific, is nearly double that of an American transcontinental railway, or more than 6,000 miles, and it was constructed at a total cost, including all incidental expenses, of nearly $250,000,000. From a European port on the Atlantic, Havre for instance, it is, therefore, possible to go by continuous connecting lines of railway a distance of nearly 10,000 miles right across two continents, or almost half way around the world. The Siberian line was not begun until 1891, and the completion of it in eleven years across the steppes of Siberia, the great rivers which flow through Asia into the Arctic Ocean, the mountain ranges and the wilderness, is the most noteworthy achievement in the history of railway construction.

Transcontinental trains on the Siberian Railway are equipped as our own railways are in America, with sleeping cars and dining cars of Russian patterns. In addition they have bathrooms, a gymnasium and a church car, which travels with the train at times, where priests hold services for the benefit of the faithful while they are speeding through the heart of Asia.

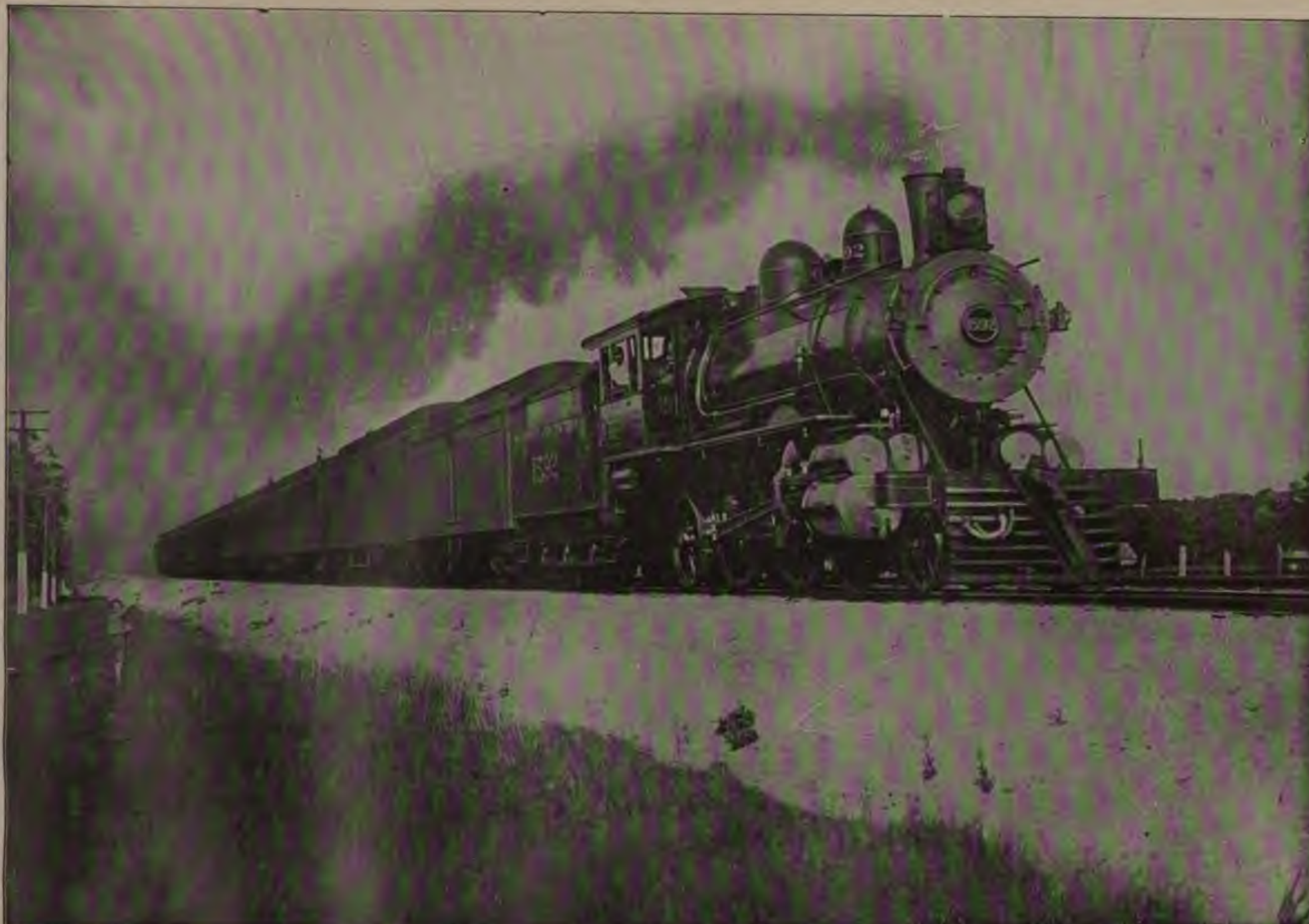
Russia has yet another railway, extending eastward into Asia from the Caspian Sea, about 1,000 miles south of the Siberian railway and roughly parallel with it. It has been completed for a distance of about 1,500 miles, and thus reaches nearly to the western boundary of the Chinese Empire. At its terminus, this line is less than 500 miles from the northern terminus of the British railways in India, and if this gap could be traversed there would be continuous rail communication between Western Europe and Calcutta. The great mountain range called the Pamirs intervenes here, however, and the connection will have to be made some day by an easier route, but little longer, across Afghanistan. It is the purpose of Russia to connect this railway with the Siberian line by a northeastern extension, and perhaps, some day also, to build directly across the Chinese Empire to the Pacific Ocean at Shanghai.

IN THE DINING CAR.

Africa is not falling behind in the matter of railway construction. Already the line of the Cape to Cairo Railway is sufficiently advanced to make a striking impression when one studies the map. From Cape Town northward it has been completed nearly to the Zambezi River, and from Cairo it extends up the Nile to Khartum, whence construction is steadily advancing. The gap is still a long one, but the surveys are made, capitalists are interested, and it promises to be not many years before the traveler can find a through train of palace cars by which he may travel the length of the Dark Continent from the Cape of Good Hope to the Mediterranean. This is a distinctly English enterprise, and except for the comparatively short crossing of German East Africa, the line traverses British territory all the way until it reaches the practically British province of Egypt. In Western Africa, the French never halt in their explorations of the Sudan, into which they are steadily pushing their railways southward from Algeria. Before many years Timbuctoo will be a way station between Algiers and Dahomey, and we may visit the oases of Sahara in palace cars.

Australia, with its immense expanse of interior desert, is not yet traversed or encircled by a railway line. The capitals of the more populous states of the new Commonwealth, from Adelaide to Brisbane, are connected by rail, and many short lines extend from ports around the coast toward the interior of the continent. From Adelaide a telegraph line extends northward across the continent to Port Darwin, where it connects with the submarine cables to Asia and Europe. A railway line has been

RAILWAY CONSTRUCTION IN THE MOUNTAINS.



TRANSCONTINENTAL EXPRESS RUNNING SIXTY MILES AN HOUR.

This train took its own picture, by opening the lens of the camera, that had been made ready, as it ran over the connecting mechanism on the track.

built from Adelaide northward as far as Oodnadatta, 800 miles into the desert, but a train service operated once every three weeks each way has not been sufficiently profitable to encourage the extension of the line. From this desert to Brisbane in the far northeast, there is consequently continuous rail connection for some 3,000 miles. What the future may bring to this great undeveloped land of possibilities hardly realized can not be predicted, but it is certain that Australian energy will not fail to multiply railway lines as fast as industry would be profited thereby. The three northern continents are crossed by railway lines. The three of the south are yet to be traversed.

INTERIOR OF A RAILWAY SNOWSHED IN THE MOUNTAINS.

SNOW PLOW AT WORK IN THE ROCKY MOUNTAINS.

GREAT RAILWAY CONSOLIDATIONS

ACROSS THE CONTINENT.

One of the most noteworthy conditions of the present day is the tendency toward enormous consolidations of American railway lines in the control of a few individuals. Within the limits of the United States we have approximately 200,000 miles of railroads, and practically half that stupendous property is in the possession of five little groups of men, who direct it from their offices in New York.

It has taken less than seventy-five years for the railway systems of the United States to grow from that first inadequate little wooden track with its lonesome locomotive of 1829 to this mileage which is sufficient to make a single track extending eight times around the world. The increase of railway mileage in the United States at this time is nearly twelve miles a day. For every five miles of railway in the country there are twenty-five men at work, one locomotive, and eight cars. The number of railway employees increases at the rate of 240 new men every day. These American railways carry more freight than all the ships of all the oceans of the world, added to one-half the traffic of the European railways. One-fifteenth of all the labor in the United States derives its support directly or indirectly out of the railway industries. When we add to these facts the recollection that the success of almost every great American industry depends upon the railways in some way or other, whether it be manufacturing, commerce, or farming, it becomes apparent what vast importance railway problems have to all of us and to the prosperity of the country at large.

There is nothing new about the tendency toward consolidation of railway lines, except the rapidity and the magnitude of the recent achievements in that line. From the day when railways first began to be constructed smaller lines have been combined to establish greater ones, with the invariable result of improved service, and, at the same time, opposition to the combination. Half a century ago passengers had to change eight times between Albany and New York, and as many more between Albany and Buffalo, even though there were railways connecting through the entire distances. And yet the consolidation of these little lines, which now seem almost ridiculous to us, met with distinct opposition, both popular and legislative, when the first moves were made, just as is the case now in regard to the greater consolidations of today.

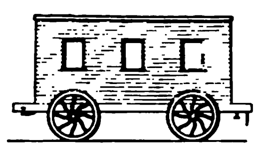
It seems fair to say that there is no essential evil in consolidation of railway systems as a principle. Such consolidations manifestly make for economy of administration and for convenience and harmony of service in the connecting lines

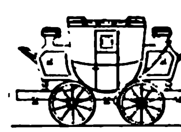
These things and the reduced rates which should naturally follow are all to the public benefit. As a matter of fact, except for short periods and in specific instances, there has never been but little real competition between railway systems. They might compete in quality of service, but clandestine pools have usually protected them from the cost of a fight among themselves.

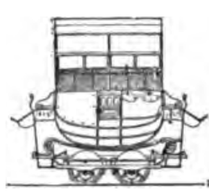
The real question, therefore, that comes from Americans in connection with the railway consolidation is whether the benefits of such union are enjoyed by the public, or are to be retained entirely as the sources of increasing wealth and power in the hands of the controlling syndicates. In the latter case it would seem as if the syndicate managers were preparing for the inevitable result of public ownership. In the former case the public may rest as contented with the present relations as it has been in the past.

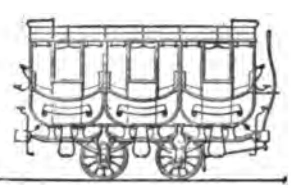
Five great syndicate interests, dominated in each case by one or two conspicuous men, control the five most important groups of railways in the United States. In addition to these, there are certain important independent lines, still outside of syndicate control, which are continually the subject of speculative rumor as to how or when they shall be absorbed.

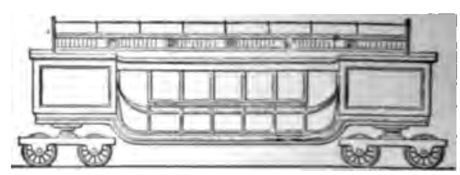
The most conspicuous of these groups, headed by the men who are today the most conspicuous, is the Morgan-Hill system, headed by J. Pierpont Morgan, the New York banker,

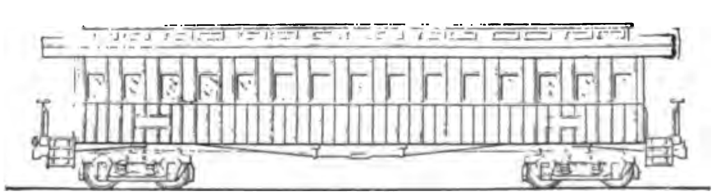

1825—First English Car on Record.

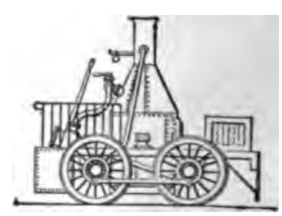

1829—Coach Body Car, the "Experiment." Stockton and Darlington R.R., England.

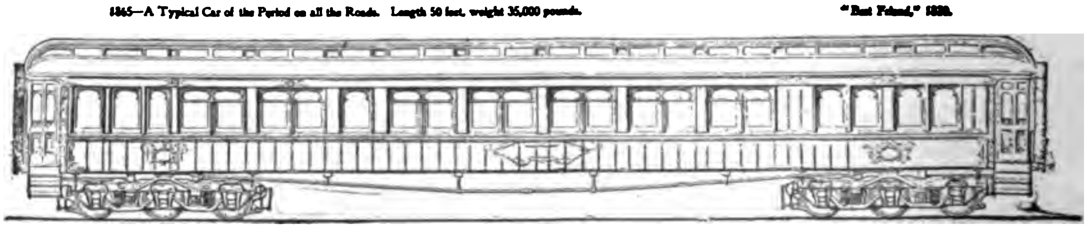

1830—The "Ohio," a Double Deck Coach Body Car, designed by Mr. Imlay for Baltimore & Ohio R.R.


1831—A Triple Body Car on the Camden & Amboy R.R., designed by Mr. Green. Drawn by horses and the "John Bull."


1836 The "Victory," also by Mr. Imlay. First car with raised roof. First car having toilet compartment and bar.


1865—A Typical Car of the Period on all the Roads. Length 50 feet, weight 35,000 pounds.


"Best Friend," 1830.


Late Sleeping Car. Length 72 feet, weight 100.000 pounds.

PICTORIAL HISTORY OF CAR BUILDING.

and James J. Hill of St. Paul, the northwestern railway magnate. The mileage which this combination controls measures a total of 37,500 miles, including two transcontinental lines from St. Paul to the Pacific coast, by the famous "merger" that brought on the attack made by the governors of the northwestern states and by the president of the United States in the federal courts to determine the validity of such union. The roads included in this system are the Northern Pacific, the Great Northern, the Chicago, Burlington and Quincy, the Erie, the Lehigh Valley, the Philadelphia and Reading, the Hocking Valley, the Southern Railway, and the Mobile and Ohio.

None of the other groups approaches this one in mileage, although in importance, wealth and profits they may not fall behind. The Vanderbilt system has a total of some 20,000 miles, including all of the New York Central lines, the Lake Shore and Michigan Southern, the Michigan Central, the Chicago and Northwestern, and the Big Four, with a host of tributaries, thus including three distinct lines between New York and Chicago.

The Pennsylvania system, with mileage approaching 15,000, now includes the Baltimore and Ohio, in addition to all of the lines formerly identified with the Pennsylvania, including the Fort Wayne, the Vandalia, and the Panhandle.

RAPID TRANSIT IN A GREAT CITY.

The Manhattan Elevated Railway in Upper New York. Height above ground nearly 100 feet.

The Gould-Rockefeller system, in which the Sage interests are also involved, includes the Missouri Pacific, the Wabash, the Iron Mountain, the Texas and Pacific, the Missouri, Kansas and Texas, and the Denver and Rio Grande, with a total mileage of nearly 17,000.

The Harriman-Kuhn-Loeb system, with

a mileage of 22,000, includes the Union Pacific, the Southern Pacific, the Oregon Short Line, the Chicago and Alton, the Illinois Central, and the Kansas City Southern. In addition to these syndicate systems of railways there still remain, as has been said, a number of independent systems with a total mileage of some 37,000, of which the Santa Fe, the Rock Island and the Chicago, Milwaukee and St. Paul are the most important. It is more than possible that several of these, particularly those of the southeastern states, will find a final refuge in the Morgan-Hill system or in some other syndicate organized for the purpose.

Says a recent student of this picturesque situation: "A strip of land hundreds of miles wide, beginning at the Washington ports in the northwest and sweeping east to the lakes, is practically an industrial fief of Mr. Hill and Mr. Morgan. In Mr. Harriman's hands, in some measure, is the prosperity of California and the southwestern states, as well as of a broad strip up the Mississippi Valley, a fertile band through the prairie states, and all the habitable land reaching west from the Rockies to the coast. The central Atlantic states live to the rhythm of the New York Central and the Pennsylvania Railroad. It is true that one can go from Boston to San Francisco, from the Gulf to St. Paul, and travel not a mile on the roads of the railroad giants, but only through a very narrow path and for the most part within view of competing syndicate lines on either side. When it is remembered, furthermore, that Morgan men are directors in Vanderbilt roads, Hill men in Pennsylvania roads, Gould men in Harriman roads, and that every other possible interweaving of common control exists throughout the great groups, the lines of demarkation melt away."

And yet, within twenty years, the average rate of freight has decreased from a cent and a quarter a ton for each mile to a little over seven mills, and the tonnage has quadrupled. The passenger rate has likewise gone down, and passenger traffic is growing 15,000,000 a year. With all these picturesque conditions in effect the situation becomes a puzzling one, and it will be of the highest interest to watch the course of events for the next few years. Whether or not we are to return to a system of individual competitive roads, whether railways will be a private monopoly or a government monopoly, can only be known after the period of adjustment has passed and the public has taken its own hand in the settlement of the proposition.

THE GREATEST FREIGHT TRANSFER YARDS IN THE WORLD.

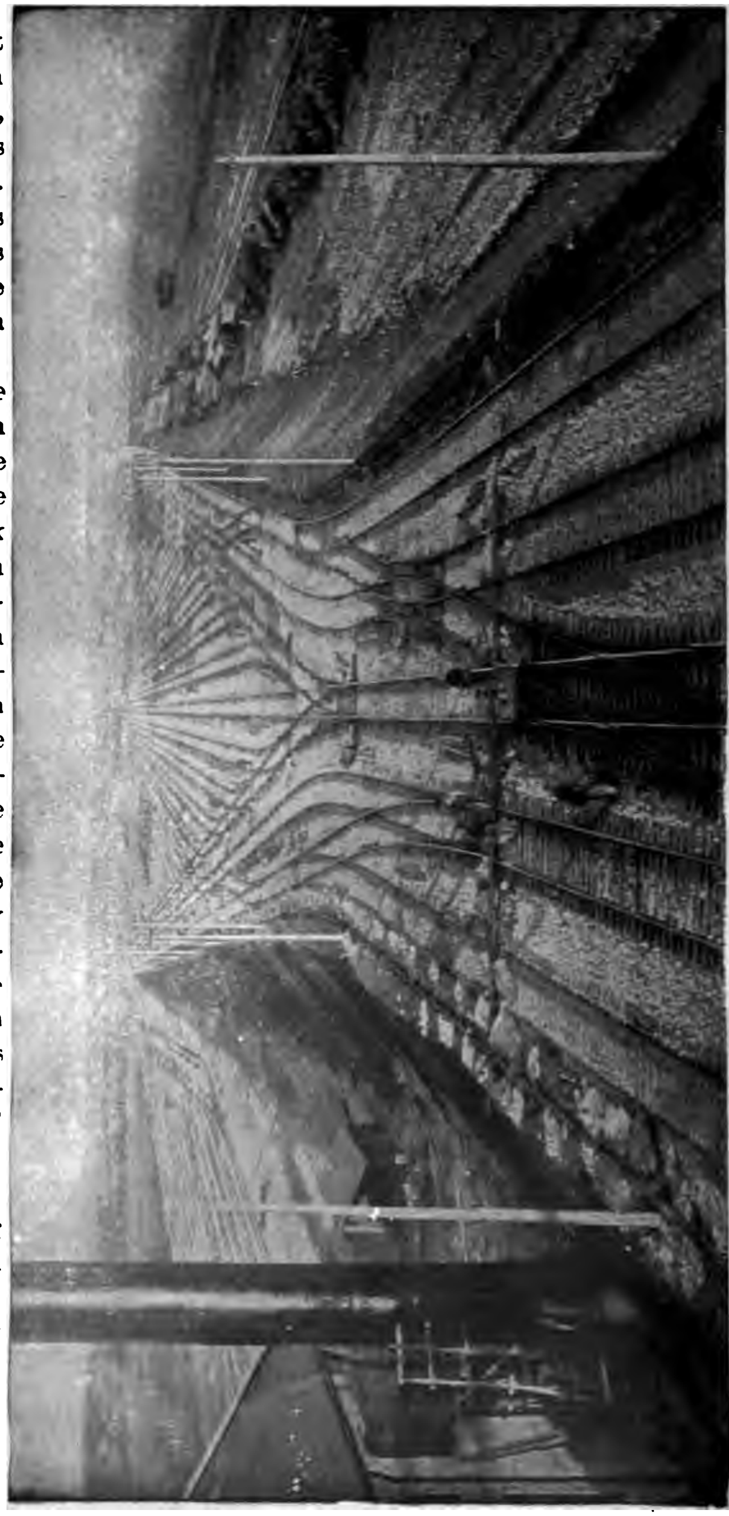
Any enterprise which promotes economy in the shipping and transfer of freight carried by the railway systems of the United States is necessarily of interest to everyone. In the end such economy results in the reduction of cost of all commodities and the consequent profit to every consumer. One of the most interesting plans to facilitate the prompt exchange of traffic has been devised in the interest of the railways entering Chicago. It is a great distributing yard where all the freight cars of all the roads can be classified for their outgoing journeys, and it thus serves the same purpose in the world of traffic that the clearing-house does in the world of finance. The volume of traffic entering and leaving Chicago by rail is stupendous. Ten thousand cars of freight are handled in Chicago every day, and of this number sixty per cent are loaded with through freight or have entered the city on one railroad and must be transferred to another. Under the superseded system most of these 6,000 cars had to be hauled over fifteen miles of track in order to properly distribute them, and this in most instances caused a delay of a whole day in making the transfer. The usual system of breaking up trains and sorting cars is at best slow and unsatisfactory, and it often happens that a through car reaching the yards shortly after the company's transfer train has left is held several hours before it can be started out for the other road.

There are twenty trunk lines entering Chicago, and the vastness of any system of switching and classifying cars that could handle the business of all of them can easily be appreciated. For years it has been done by the various belt lines that were compelled to operate a total of twenty-seven different yards, which are from a tenth of a mile to sixteen miles apart.

In order to obviate all of this duplicated labor and expense, a new system was perfected whereby the difficulties of the former plan have been overcome by centralizing the work in one immense clearing-yard. Under this arrangement it is claimed 8,000 cars can be switched and handled in a single day, and this is an important achievement to the managers of the railway companies, who had long realized the wastefulness of the ancient system. All of the railway lines entering Chicago united in a mutual organization for the purpose of establishing and operating these great yards, so that it was assured that they would make immediate use of the system as soon as it was completed.

The new clearing-yard is located west of Chicago, a few miles beyond the city limits, and is connected with three of the belt lines which encircle the city and communicate with all of the railways interested. The original plans for the undertaking were formed some years ago by President A. B. Stickney of the Chicago Great Western Railway, and a beginning was made at that time. From him the tract took its name of Stickney, but the work was interrupted before a great deal had been accomplished, and in the newer reorganization an entirely different plan was put into effect. The tract available for these great clearing yards is about two by five miles, but at the beginning not near all of this area was be thus utilized. The first yard is 670 feet in width and 13,000 feet in length, its greater measurements being east and west. There is room for this yard to be duplicated as many times as may prove necessary with the growth of traffic in Chicago.

Extending along the whole length of the north and south boundaries there are three thoroughfare tracks, with double track "Y" connections at each end to the belt lines. Bisecting the yard, on an east and west line, is a central through track known as "track No. 25." There are two sets of classification tracks, known as the "classification yards." The tracks in these yards are 2,400 feet long and they extend the full width between the thoroughfare tracks. Midway between the two classification yards is an artificially constructed "gravity mound," and on each side of it and parallel to it on the level plain are sets of receiving tracks which are from 1,600 to 3,200 feet in length. The gravity mound has an elevation at its summit of 21½ feet above the general level of the yard. For a short dis-



CHICAGO TRANSFER YARDS—LOOKING EAST FROM SIGNAL TOWER ON GRAVITY MOUND.

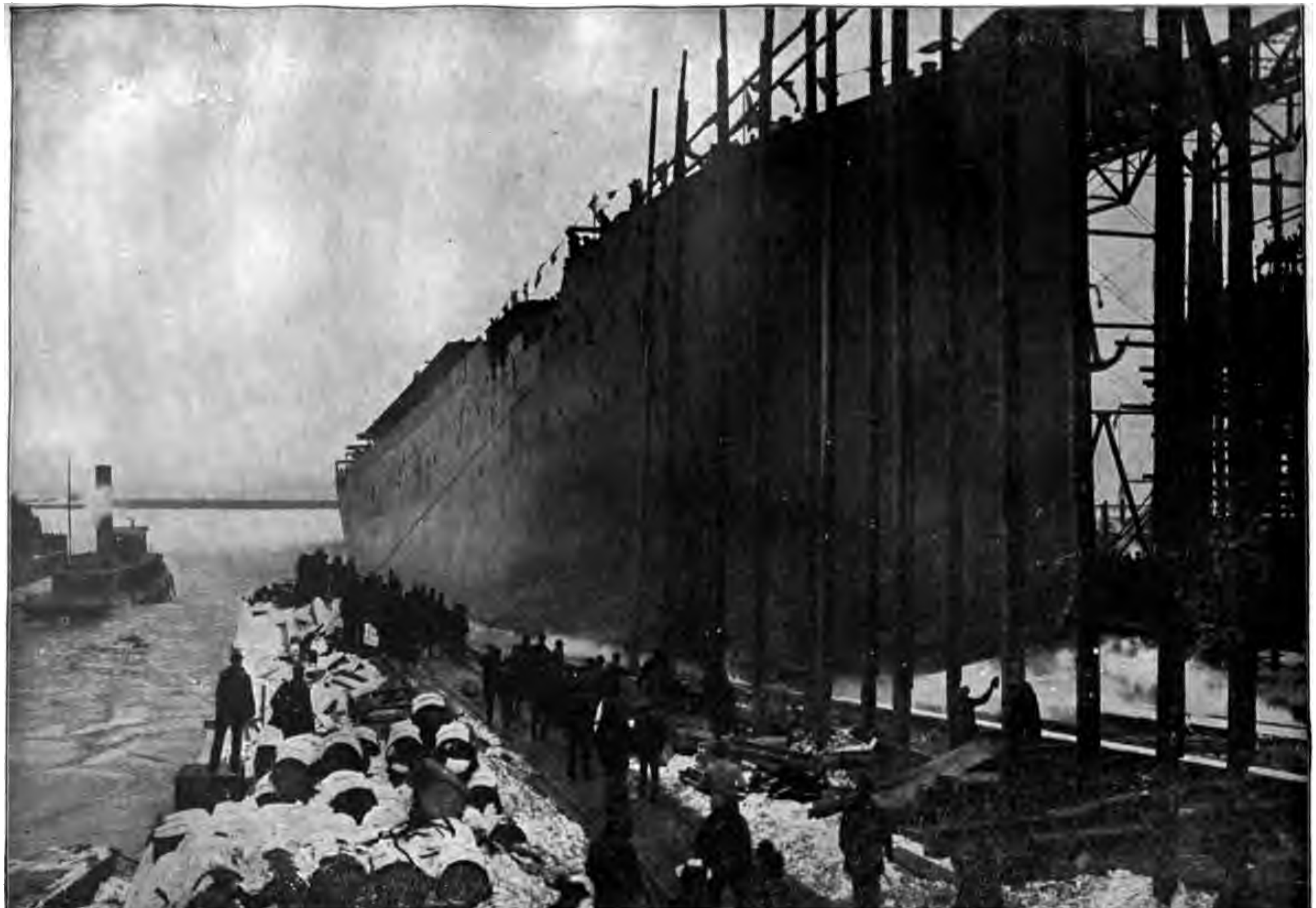
tance each side of the summit there is a grade of 1½ per cent and then for a distance of 1,800 feet a grade of 0.9 per cent, and a grade of 0.5 per cent for a distance of 300 feet further, the foot of the gravity mound tracks being several hundred feet beyond the apex of the classification yards.

Running diagonally across the classification yards there are double "ladder tracks," and east and west of the classification tracks there are parallel overflow tracks, which extend parallel with the classification ladders at the outer end of the classification yards. Parallel with the double ladder at the inner ends of the classification tracks are two tracks, the one next to the ladder being a "poling" and the outer one a "drilling" track. The double ladders, which connect by switches with each track in the classification yard, converge at a three-throw switch into the central track, No. 25, already mentioned, which extends through the center of the whole yard. Consequently there extend over the summit of the gravity mound five parallel tracks with leader tracks and crossovers.

The object of the gravity mound is to allow the transfer of the various cars to the various classification tracks to be accomplished by gravity and save a great amount of engine mileage, which would necessarily be if the cars had to be pushed on to the various tracks by switching engines. The method of operation is as follows: A train coming in at either end of the yard is run into one of the receiving tracks, where the engine is uncoupled and takes back a made-up train from one of the classification tracks. One of the clearing-yard switching engines then couples on to the train, backs up and pushes it over one of the drilling tracks, which we have mentioned above as lying alongside the classification ladder.

As the train is pushed up the summit the couplers are disconnected at the proper places in the train, and as the cars go over on to the down grade on the other side of the summit they separate from the train and run down on the central track, No. 25, to the three-throw switch at the apex of the classification ladder. Here they are switched to either side of the double ladder and finally into the desired track of the classification yard.

The great yards thus described were finished and ready for operation in the fall of 1902, and after that time all freight traffic entering and leaving Chicago passed through them for classification. In addition to the form of the enterprise as outlined, it is expected that a series of great warehouses will be built and placed at the disposal of the wholesale houses of Chicago, so that they may receive their shipments here at the clearing-yards and distribute them again to their customers without bringing them into the city proper. It is manifest that the establishment of such a system of warehouses will go far to relieve the streets of the city of the immense traffic that now congests them, and that every citizen will find himself profited thereby, and by the additional comfort and quiet of the streets. Furthermore, it is contemplated by the railway companies which have established this yard that the exceptional shipping facilities thus created will induce the location of large numbers of factories. From such a beginning, therefore, it is natural to expect the growth of a great industrial and manufacturing community that will be one of the more conspicuous features of the commercial development of the great city.



LAUNCH OF THE "KROONLAND," CRAMPS' SHIPYARDS, PHILADELPHIA.

This is a passenger and freight steamship for Atlantic service, 560 feet long and with engines of 10,000 horsepower.

THE AMERICAN INDUSTRIAL INVASION OF EUROPE

The American industrial invasion of foreign lands has reached such proportions as to disconcert and even alarm many thoughtful men abroad, who see their countries being exploited for American profit and their opportunities utilized by American energy. American industrial pioneers are entering the activities of Europe, Asia and Africa, in competition with the English, French, Germans and Belgians, who have believed themselves to be safe in their monopoly of their respective fields of endeavor.

Even in London, an English builder, manufacturer, engineer or promoter finds his American rivals at every turn. Great American manufactories are establishing branches in England, and in some instances actually buying out their former English competitors. In 1901, the British match-manufactories were absorbed by the American match trust, a fact which greatly disturbed English students of commercial and industrial conditions.

A striking achievement was made a year later by an American builder, who practically completed in ten months a huge work that the most enterprising of British contractors declared could not be done in less than five years. He shook the traditions of British bricklayers, carpenters, builders and theorists to their foundations. The London Times devoted one of its ponderous editorial columns to a lesson to the British workmen, based on this American contractor's success, and other papers all over the British Isles took up the refrain.

The British Westinghouse Company, which was to supply the electric fittings for most of the underground railways that American capitalists were building in London, found it necessary to erect one of the greatest electrical plants in the world at Manchester. Being to all intents and purposes a British company, they were naturally very anxious to give the British contractors the job of building it. A Manchester company got the contract for foundations, and a London company for the steel work, both these contracts being allotted in May, 1900. Neither of the concerns could "see their way" to saying when the work was likely to be done. The foundation people thought the matter over and finally began the work in July. In November the foundation of one of the largest buildings was in such condition that the steel work could be begun, and then the London contractors arrived on the scene and the work proceeded in an eminently dignified way.

Meanwhile the capitalists were making things hum, extending their systems right and left, pushing through plans for the electrification of old-fashioned steam lines with such rapidity that it made the old-fashioned stockholders dizzy to think about, and pouring huge hurry-up orders on the Westinghouse Company.

At the gait things were going the new plant would not be ready in time to fill the orders, and the great enterprise would be delayed, at a cost that might be disastrous. George Westinghouse promptly took a hand in it, and told the contractors that the whole group of buildings must be ready in two and a half years. The contractors threw up their hands in holy horror. It couldn't be done in less than five. No man on earth could do it in less than five.

The situation was serious, for it was beginning to look as if even two and one-half years was going to be too long to wait. Then somebody called to mind the doings of an American contractor named Stewart, head of the firm of J. C. & A. M. Stewart, of St. Louis, Pittsburg and New Orleans, who had taken in hand the principal building of the Pittsburg Exposition when it had burned down three months before the day the show was to open. Stewart had it up again and finished ahead of time. His rush work on some grain elevators was so striking that a novel had been based upon it. He had restored the Galveston system of docks and storehouses in forty-five days from the time they were destroyed.

The Westinghouse people told Stewart they wanted him to take the Manchester job, and finish it in fifteen months. The agreement was signed in Pittsburg, and the contractor took the first steamer for Liverpool. He had never been in England before, and did not know what was waiting for him. He landed on January 24. One week later his best two men got four hours' notice to start for England. One of them was in New Orleans and the other in Toledo, O., but they both caught the Teutonic two days after. Before they could reach England, however, Stewart was hustling home aboard the Oceanic. The two men stopped at Queenstown, hired a tender and went out to meet the Oceanic, and had a bundle of minute instructions as big as a log of wood tossed to them. The next day they were at the Manchester works, and things had begun to happen.

Three weeks later, Stewart, who had been collecting some of his good men, and buying American appliances for handling work, was back in Manchester. He brought ten young Americans, whom he had trained himself, and with them he sailed into the biggest fight of his life. For the next few weeks he and his little band got about four hours' sleep per night. They "rushed" things all day and spent half the night in discussing how they were to be rushed the next day. Stewart slept in a little hotel within a hundred yards of the work. His two men slept on the plans in the office. They were working every morning at six.

When the American took charge of affairs at Manchester there were 236 men on the job. In four weeks there were 2,500. Stewart had an advertisement in each of the largest provincial papers, saying that carpenters and bricklayers were wanted, and they came in from all over the country. As soon as a man came in he was set to work. He got a fair trial, and if he was no good he was discharged. Every morning Stewart and two of his men made a complete tour of the work, and all three took note of how things were progressing. Every gang of men that didn't get ahead fast enough had an American foreman placed behind him. Every day's work was carefully measured and compared with the record of the day before. If there was no improvement the contractor found out why.

Before going any further, it may be well to give a few rather striking figures that tell better than any technical description could, what sort of a job the American contractor had tackled. The plant as it was completed is the biggest in the world ever built at one time. When Mr. Stewart was asked with what one could compare it, he mentioned the Westinghouse factories at Pittsburg and the General Electric Company's plant at Schenectady. It consists of nine immense buildings, the office building, machine shop, box-factory, power-house, steel-foundry, iron-foundry, brass-foundry, pattern-shop, and dipping and drying-shop. The cost of the buildings was about $7,500,000. Twelve million feet of lumber were used, and 5,000,000 bricks, 750,000 feet of glass, and 40,000 square yards of paving, or enough to pave a street three miles long. About 4,500 men were employed.

Putting up this building was a fight from the start. No sooner was one obstacle overcome than another popped up. In the first place, the sub-contractors would not put on enough men. They had ten men on the job where a hundred have been used in America, and when Stewart insisted on the force being doubled or quadrupled, they wailed that they could not look after so many men. So they put the men on and Stewart did the "looking." Sometimes they wanted to back out of their contracts, saying that they couldn't buy the material and make any profit; so Stewart went out and bought it for them. When they said they couldn't get some little job finished, he told them that there was $100 extra in it for them if they did, and somehow the job was done on time. When bulldozing worked best he bulldozed and held their "penalties" over their heads; when they seemed like to stand out he cajoled.

THE FIRST AND ONLY SEVEN-MASTED SCHOONER IN THE WORLD.

This steel craft is not only the largest fore-and-after ever built, but it is the largest sailing vessel of any kind in the world. It is 388 feet long at the water line, 50 feet wide and carries 8,000 tons of cargo with a crew of only 16 men. Built in Boston, 1902.

The railway terminus was not far from his works, and the contractor built a line from the depot to the grounds and ran a section of it into every building. Two hundred and fifty carloads of stuff were coming in every day, and Stewart's little engine was kept breathless, shunting it where it belonged, but the supplies were not enough to keep pace with the work. The fault was the contractors' again. They notified the American that they had shipped goods, whereas the men he sent flying to look them up found the stuff piled up in their yards. He insisted on his advices being sent by telegraph, and, insisted, too, that every shipper supply the car numbers in which the stuff was sent, a demand that never before had been made in England. He had his men all over England following the cars. They called on railway superintendents and asked why cars did not get along faster, and kept hammering at the officials until they did something.

In dealing with his men he had first to fight their prejudice against him because he was a "damned Yankee." The more they saw of him, though, the better they liked him. He made a policy of keeping every promise he made them. If he said he would pay a man extra for a job, the man got his pay. If he threatened to "fire" a man if he didn't do better, the man was fired. He paid his men two cents an hour above the union wages. He allowed them "walking time"—half an hour in the morning to get to the works. He kept a supply of hot water to be served out to them for their tea. When they did a job especially well, he treated them all to free beer. The union rules of England did not allow him to pay the men that did the most of the work the best wages, but he got around that by keeping only the best men and discharging the rest.

And he made them work as they had never dreamed of working before, and as none of the men who had been blaming the British laborer for the decadence of British trade had ever dreamed they could work. One reason was that Stewart is a practical man himself. He studied under his father, who was an architect, and then went out and worked at other trades. He can lay a brick and can cut stone and do carpentering, as the men have discovered.

The way in which he shook up the bricklaying part of the job is a fair specimen of the things he did to the men's long accustomed ways. When the work first began, bricks were being laid as they are laid everywhere in England, at a rate of about 400 a day. There were no steam "hoists" for sending the brick up to the scaffolding, and the men were using stiff mortar. Under the new regime automatic "hoists" were set to work in a jiffy, and soft mortar was supplied to the men.

Stewart explained to the men personally how, by using the American mortar, they could lay enough with one stretch of the trowel for six or a dozen bricks, and lay the bricks themselves by a light pressure of the hand and a light tap with the trowel, instead of by repeated hammering to force the brick into the stiff mortar. He told them to their horror and amazement that bricklayers in America laid 2,000 bricks a day and thought nothing of it. He had hardly got the words out of his mouth, however, when one of the men contradicted him bluntly. He said he had been in America and he knew how bricks were laid there. Stewart, looking, as usual, as if he had just come out of a men's furnishing shop, with glossy derby, natty business suit, and patent leather shoes, was standing on the ground and talking to the men on the scaffolding above. He jumped for the ladder leaning against the building, and in four steps was standing on the scaffolding beside the man who had contradicted him. He rolled up his sleeves, and, filling a trowel with mortar, he laid four complete rows of bricks with a deftness and dispatch that made the men's eyes stick out of their heads. Then he went on, but left an overseer behind him to see that the men worked faster and faster. Little by little he got them along, until, finally, they, too, could and did lay 2,000 a day. Yet the London County Council, the governing body of the metropolis, reported recently that the average of bricklayers on municipal works was "over" 330 a day.

The "boss" got just as striking results with the other men as with bricklayers. When he arrived the carpenters were averaging 500 feet of timber a day, and they finally averaged 1,000. The steel workers were doing their riveting by hand, and the union tried to make trouble; Stewart insisted that automatic riveters be used. In the beginning the men disposed of from ten to fifteen tons of steel a day; they learned to use up 100 tons. Their first rate of riveting was fifty rivets a day; long after it was from 200 to 300.

The work as originally ordered was done in ten months from the time the American "hustler" took hold, but the company made certain changes in the plans and extended the undertaking so that several months'

NEW YORK DOCKS.
Ocean Freight Vessels that carry our goods to foreign ports.

additional work were required. Mr. Stewart had an experience which, while financially profitable and a valuable lesson to his English rivals, was trying to his own powers of endurance. Various liberal offers were made to him by important London institutions, urging him to stay and continue similar work in their behalf, but he declared that it was too big an undertaking for one man to revolutionize a whole country. "Mr. Westinghouse made it a big object for me to come over here," he said, "and I am going back from $30,000 to $40,000 better off than when I came, but I said to him when the work was done, 'you have had the best five years of my life, but you have had that all in one.' "

EAST RIVER DOCKS, NEW YORK. Vessels from foreign ports unloading cargo.

OCEAN TRAFFIC—ITS STUPENDOUS GROWTH

In no branch of industry has progress been more noteworthy than in the construction of the ships that sail the seas. Between the hollow log on which the first savage mariner floated across a lonesome river, and the caravels with which Columbus sailed to discover a new world, the difference was not greater than between those little Spanish vessels and the ocean greyhounds which now speed back and forth, like shuttles weaving the threads of commerce together over all the world. Even the Great Eastern, which for more than forty years held the record as the largest vessel that had ever floated, is now surpassed by Atlantic liners in regular service. And that famous old craft was chiefly distinguished for its size, proving unprofitably slow and inadequately engined.

Greatness is a relative term, and sometimes one vessel excels others in one measurement, while itself excelled in another. Length, breadth, depth, carrying capacity and other qualifications enter into the tests of merit, and the accompanying table will serve to indicate these details for the most famous of recent Atlantic liners:

Ship—	Date	Length over all, feet.	Beam, feet.	Depth, feet.	Displacement, tons.	Gross tonnage.	Speed, knots.
Great Eastern	1858	692	83	57½	27,000	18,915	14½
Paris	1838	560	63	42	15,000	10,500	20
Teutonic	1890	585	57½	42	13,800	9,984	20
St. Paul	1895	554	63	42	16,000	11,600	21
Lucania	1893	625	65	41½	19,000	12,950	22
Kaiser Wilhelm	1897	649	66	43	21,000	14,349	22.8
Oceanic	1899	705	68	49	32,500	17,274	21
Deutschland	1900	686	67	40 1-3	23,500	15,500	23.5
Celtic	1901	700	75	49	37,700	20,880	16

It will be seen that there is a gradual steady increase in the size of such craft, except that the Celtic, greatest of all, is slower than some of its immediate predecessors. This seems to suggest a tendency toward slower boats once more, on account of the very great expense of driving such enormous bodies through water at the highest rate of speed. The additional space required for coal, deducted from cargo

THE CAMPANIA, A PASSENGER GREYHOUND OF THE ATLANTIC.

(Length, 625 feet; breadth, 65 feet; displacement, 19,000 tons; speed, 22 knots, or 25 statute miles, an hour; capacity, about 2,200 passengers.)

capacity, the cost of the great increase in coal consumption, and the great additional engine power required for adding every mile above sixteen knots an hour, go far to destroy the profits on a great steamer, and except when compelled by the force of competition, owners prefer a slower schedule for the voyage.

A dozen or more important transatlantic lines maintain regular passenger service between the ports of the United States and Europe. Here are some figures which indicate the magnitude of the provision that must be made for the sustenance of passengers and crew during the voyages. They refer to a vessel which is by no means the largest nor the newest of the ocean greyhounds, but they are no less significant. The same facts would take even more striking form if they were applied to such vessels as the Deutschland or the Oceanic.

For a single passage to America the Etruria, with 547 cabin passengers, and a crew of 287 persons on board, carries the following quantities of provisions: 12,550 pounds fresh beef, 760 pounds corned beef, 5,320 pounds mutton, 850 pounds lamb, 350 pounds veal, 350 pounds pork, 2,000 pounds fresh fish, 600 fowls, 300 chickens, 100 ducks, 50 geese, 80 turkeys, 200 brace of grouse, 15 tons potatoes, 30 hampers of vegetables, 220 quarts of ice cream, 1,000 quarts of milk, and 11,500 eggs (or at the rate of one egg per minute from the time the ship sails from Liverpool until her arrival in New York).

The quantities of wines, spirits, beer, etc., put on board for consumption on the round voyage comprise 1,100 bottles champagne, 850 bottles claret, 6,000 bottles ale, 2,500 bottles porter, 4,500 bottles mineral waters, 650 bottles various spirits.

Crockery is broken very extensively, being at the rate of 900 plates, 280 cups, 438 saucers, 1,213 tumblers, 200 wine-glasses, 27 decanters, and 63 water-bottles in a single voyage.

As regards the consumption on board the whole Cunard fleet for a single year, the figures seem almost fabulous—4,656 sheep, 1,800 lambs, 2,474 oxen are consumed—an array of flocks and herds surpassing in extent the possessions of many a pastoral patriarch of ancient times—besides 24,075 fowls, 4,230 ducks, 2,200 turkeys, 2,200 geese, 53 tons of ham, 20 tons bacon, 15 tons cheese, and 831,603 eggs.

Other articles are in extensive demand, and in the course of a year there is consumed one ton-and-a-half of mustard, one ton and three-quarters of pepper, 7,216 bottles of pickles, 800 tins sardines, 33 tons salt cod and ling, 4,192 four-pound jars of jam, 15 tons marmalade, 22 tons raisins, currants and figs, 18 tons split peas, 15 tons barley, 17 tons rice, 34 tons oatmeal, 460 tons flour, 23 tons biscuits, 33 tons salt, 48,902 loaves of bread of 8 pounds each.

The Cunard passengers annually drink and smoke to the following extent—8,030 bottles and 17,613 half-bottles of champagne, 13,941 bottles and 7,310 half-bottles claret, 9,200 bottles other wines, 489,344 bottles ale and porter, 174,921 bottles mineral waters and 344,000 bottles spirits; and 34,360 pounds tobacco, 63,340 cigars, and 56,875 cigarettes.

The heaviest item in the annual consumption of the company is of course coal, of which 356,764 tons are burnt, nearly equal to 1,000 tons for every day in the year.

With regard to the aggregate employment of labor by the Cunard Company, it includes 34 captains, 146 officers, 628 engineers, boiler-makers and carpenters, 665 seamen, 916 firemen, 900 stewards, 62 stewardesses, 42 women to keep the upholstery and linen in order, with 1,100 men of a shore gang, or about 4,506 people to run the ships, which traverse yearly a distance equal to five times that between the earth and the moon!

SHIPWRECK ON THE OCEAN.
Terrible storms and collisions in fogs sometimes cause frightful disasters and the loss of many lives.

Great Britain, France, Germany and the United States are the homes of the great shipyards of the world. Russia, Austria, Italy and Japan, it is true, have their shipyards where the smaller vessels for their own service are built, and even in some instances great battleships. But generally speaking, even they and most other nations come to the countries first named for most of their more important naval constructions. In the United States, several great shipyards build our men-of-war and the passenger liners of American companies. At San Francisco, for instance, was built the Oregon, which became the most conspicuous battleship in the world by virtue of its wonderful voyage from Puget Sound to the Caribbean Sea by way of Cape Horn and thence to the Philippine Islands, during the Spanish-American war. On the Atlantic coast Philadelphia, New London and Newport News are known as the location of the most important American shipyards. Here great battleships are constructed, not only for our own navy, but for the navies of Japan, Russia and other countries. Here, too, have been built many of the largest and finest ships that cross the Atlantic and the Pacific Oceans in passenger traffic. The New England shipyards still build many of the sailing vessels, in which Yankee sailors have carried the American flag to every quarter of the world, and of late years there appears to be a revival of the popularity of sails, in spite of the great increase in the steamship fleets.'

As the world tends to become smaller, with the extension of international trade and friendship, it becomes more important and more profitable to develop the shipping industries upon these highways which nature has provided free to all. There was a time when the Yankee skipper, the Yankee sailor and the Yankee ship stood at the head of the list, with a just share in the world's commerce. In later years this condition changed, and the American flag has not been so well known in the ports of the world as it was from 1830 to 1860. Again the pendulum is swinging in the other direction, and we have the prospect that in a few years Americans will once more begin to control their share of ocean commerce. The same men whose genius in organization unites railways, banks, steel mills, packing houses and the other great industrial and commercial enterprises, into powerful syndicates making themselves felt the world over, have turned their attention to this department of business activity, and the results are bound to be seen.

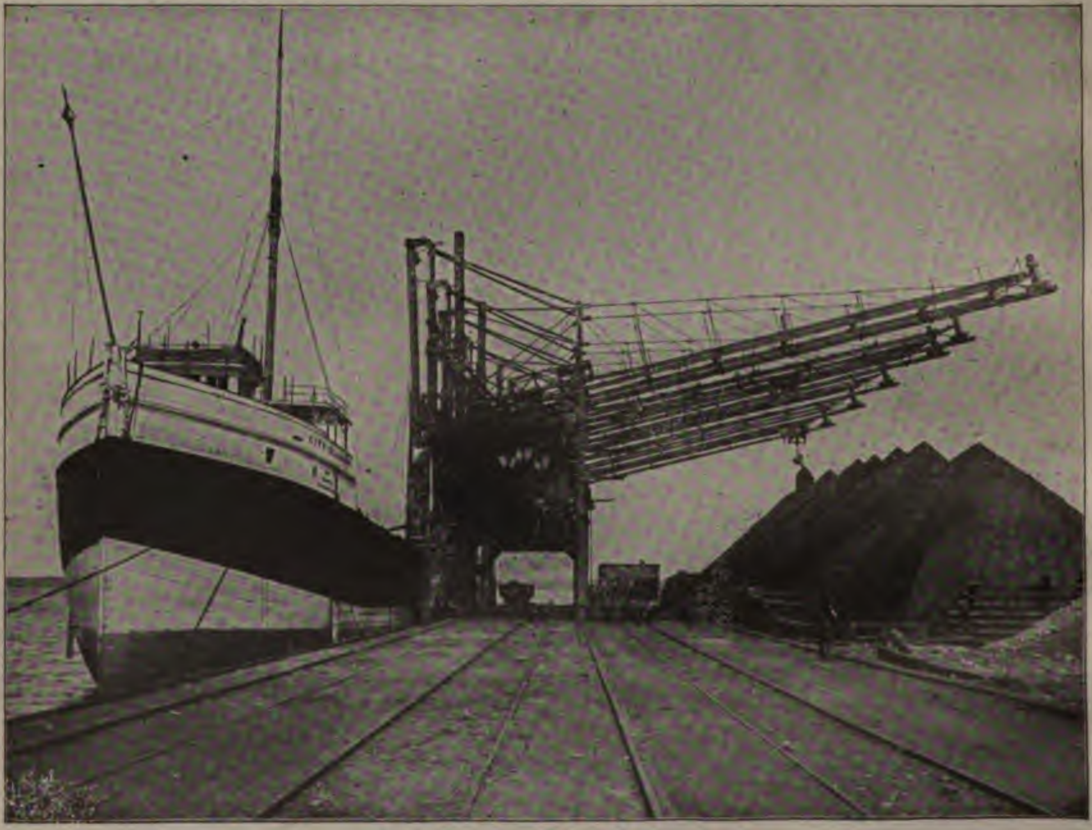
THE GREAT PHILADELPHIA SHIP YARDS.

Showing an Ocean Liner in the dry dock for repairs.

SHIPPING ON THE GREAT LAKES

From the Atlantic Ocean to the very heart of the American continent, by way of the St. Lawrence River and the Great Lakes, there is a commercial route over which traffic passes throughout the eight months of open navigation every year, so immense in its magnitude that it never fails to astonish those who consider it for the first time. From Niagara Falls to the sea this route is virtually uninterrupted for more than 1,000 miles, except by the short canals which are necessary to pass around the rapids of the St. Lawrence. Niagara Falls, however is an obstacle difficult to surmount, and although the Welland Canal, connecting Lake Erie and Lake Ontario, makes it possible for vessels to continue their journey, yet in practice not a great deal of the trade is carried through uninterruptedly.

From Buffalo to Duluth at the head of Lake Superior, and Chicago at the head of Lake Michigan, however, the travel routes are unbroken. Indeed there is no interruption in direct navigation among all the ports of the upper lakes, except that at Sault Ste. Marie the United States Government has built a great canal lock, the



IRON ORE DOCKS ON LAKE ERIE.

and West Su-
r, at the
of this
t lake,

ENTRANCE TO CHICAGO RIVER FROM LAKE MICHIGAN.

This is a bird's-eye view of the city freight yards of the Illinois Central Railway at Chicago. The tract thus occupied lies at the mouth of the Chicago river, and the docks and elevators are convenient for an exchange of freight with the railway. Michigan avenue is the street at the extreme left, and in the distance appears the boulevard leading north along the lake shore to Lincoln Park.

IRON MINE IN THE LAKE SUPERIOR REGION.

also ship immense quantities of grain from the wheat fields of the northwest. It was at the shipyards of West Superior that those peculiar craft, the "whalebacks," known to all lake men as the "pigs," were built, and in them are carried millions of tons of grain, ore and coal every season. There is no trouble in finding return cargoes for vessels on the Great Lakes, whichever way they sail. The great wheat, lumber and ore carriers from Lake Michigan and Lake Superior discharge their cargoes at Detroit, Cleveland, Erie or Buffalo, and return laden with coal or manufactured products, so that there is a constant exchange between east and west, with profit to all interests concerned.

Few people realize that the traffic on the great lakes of North America is one of the largest industrial enterprises in the world. The commerce of such a port as Chicago is as great as that of New York. The volume of traffic passing up and down through the great canal connecting Lake Superior and Lake Huron at Sault Ste. Marie, is greater than that passing through the Suez Canal, and the traffic passing the city of Detroit on the Detroit River is much greater than the ocean traffic at the port of New York City.

For a few months in the winter all this navigation system is closed by ice, and traffic is halted until the ice breaks up in the spring. It is evident, therefore, that the date of opening navigation is of great importance to the immense interests involved. So regular is the season, that steamship owners are able to calculate in advance about what time the first vessels may pass through the narrow channels connecting the different lakes. But sometimes all rules fail. In the spring of 1901 navigation was closed by ice later in the season than it had been for fifty-seven years, or virtually since the trade of the lakes grew to important proportions. The April ice jams forbade communication between the upper and lower lakes until well into the month of May, a whole month later than the average date of opening. Of course, every day's delay meant great loss to vessel owners and those who were dependent upon shipments by water, and the total loss in this month of delay reached an enormous figure.

There are three places that are watched for the signs of opening navigation. These are, respectively; the St. Mary River, which connects Lake Huron with Lake Superior; the Straits of Mackinac, connecting Lake Michigan and Lake Huron, and the St. Clair River, connecting Lake Huron with Lake St. Clair, just above Detroit. The last of these being the farthest south, is usually the first to open, and when vessels find a channel through the straits of Mackinac, that is usually considered as a signal that navigation from the upper to the lower lakes is once more free. In 1901, however, although the Straits and the "Soo" were open to free navigation almost as early as usual, it was not possible to go from Lake Huron into the lower lakes. A succession of northeast winds carried the great ice floes of Lake Huron into the southern extremity of the lake, where they packed and jammed instead of melting and scattering in open waters, as they would have done under other circumstances. The current of the lakes flowing into the St. Clair River at this point aided the winds in blocking up the narrow channel, and the result was that a solid mass of ice accumulated at the foot of Lake Huron, perhaps fifteen by twenty-five miles. The jam extended into the St. Clair River, which is about thirty miles long, and for weeks that stream was packed solidly with the great cakes of ice.

All the vessels which had sailed from ports on Lake Michigan and Lake Superior were blocked by ice jams above, and all those from the lower lakes were held at Detroit, unable to go farther up stream. It was not until April 29 that one boat got through to Detroit from the upper lakes, and two days later fourteen came through. After that the jam packed solidly again, and it did not finally open until the 8th of May. In the St. Clair River itself, and in the narrow canal which extends from the mouth of the river into deep water in Lake St. Clair, the ice cakes had actually filled the stream from top to bottom until a great dam was formed. Above the jam the water rose, but below fell so far that in Lake St. Clair and the Detroit River navigation was greatly embarrassed by the shallow water.

Although the commercial loss by this unfortunate delay was great, the people who lived on the St. Clair River and in Detroit and other neighboring cities had some recompense in the picturesque and interesting conditions that existed. On shore the season was almost summerlike, with flowers, grass and foliage as far advanced as ever in early May. Excursionists by the hundreds came out on the electric cars that run along the river bank, wearing their summer suits and straw hats, to see the marvelous masses of ice that were blockading the commerce of the lakes. Scores of great vessels were held captive for from one to four weeks, some of them above or below the ice jams, and others in the very midst. The latter experienced all the sensations of Arctic exploration, cut off from shore as they were, except when they sent men to make perilous trips back and forth over the ice for provisions.

When the jams finally began to break, and the glacier-like masses began to race down stream again, the vessels held in their clutch were at times in great danger. Docks along the shore were torn to pieces, vessels were dragged from their moorings and in some instances badly damaged, and others were left aground. Altogether the conditions were memorable, and those who had occasion to deal with the lake traffic at that time earnestly hope that nature may play no more such tricks upon them.

AREA OF THE GREAT LAKES OF THE UNITED STATES.

	Superior.	Michigan.	Huron.	Erie.	Ontario.
Greatest length in miles	390	345	270	250	190
Greatest breadth in miles	160	84	105	60	52
Greatest depth in feet	900	1,800	1,000	204	412
Area in square miles	32,200	22,400	23,000	10,000	6,700
Drainage in square miles	85,000	70,040	74,000	39,680	29,760
Height above sea-level in feet	600	578	574	564	234
Latitude, degrees north	46° 45′ 48° 50′	40° 15′ 46° 55′	43° 20′ 60° 10′	41° 20′ 42° 50′	43° 10′ 44° 10′
Longitude, degrees west	84° 30′ 92° 15′	84° 40′ 87° 08′	80° 10′ 84° 30′	78° 35′ 83° 10′	76° 20′ 79° 50′
Boundary lines	300	None	220	200	160
United States shore line in miles	955	1,320	510	370	230

PASSENGER STEAMER SHOOTING THE LACHINE RAPIDS ON THE ST. LAWRENCE RIVER.

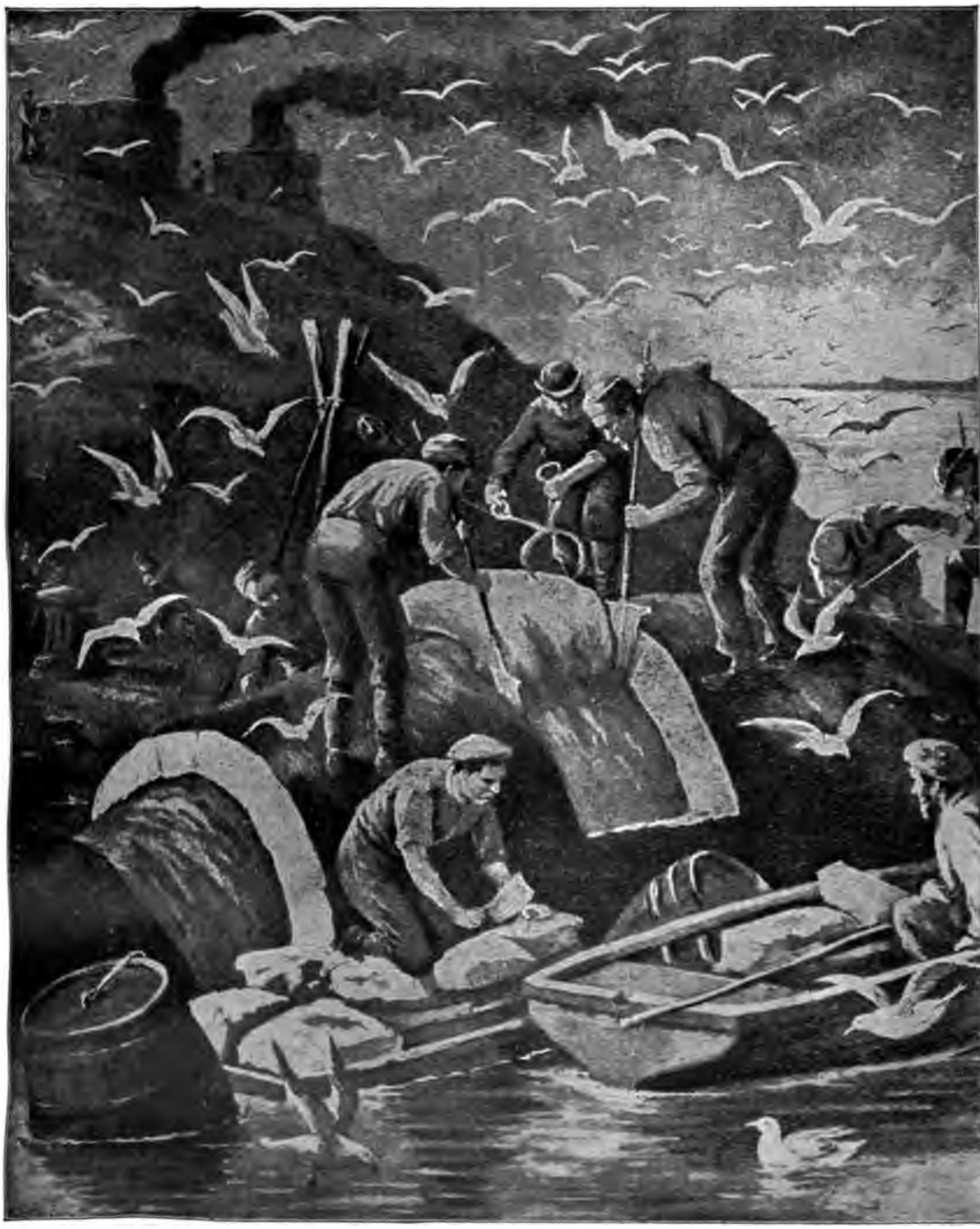
ALONG THE WATERFRONT, NEW YORK CITY.
Showing passenger steamers from the Tropics lying at the docks, with Brooklyn Bridge in the background.

THE GREAT INDUSTRIES OF THE SEAS AND LAKES

Through all the ages, man has drawn a large share of his sustenance from sea foods, and as the industrial organization of the world has advanced, so the industries which depend upon the products of the ocean grow in size. To-day fishermen in large numbers pursue their vocations in steam craft instead of sail boats; refrigerator cars running on all lines of railway distribute sea food to inland markets in all its delicacy; even the firms and the companies which formerly conducted fishing operations in a small way have begun to form their own corporations, syndicates and trusts, so that in our time all processes of modern commercial energy are enlisted in what was once one of the most primitive of industries.

No longer does the whaler tell dramatic stories of his dangerous pursuit of the monster of the deep, of armslength charges with the harpoon, of overturned boats, and ferocious assaults by the wounded prey. Instead, steam-powered whaling ships seek the far north, armed with peculiar guns from which they hurl fatal missiles at long range, with safety to themselves. Whaling indeed is no longer as important an industry as it once was. Various artificial substitutes for whalebone have been invented, while mineral, vegetable and animal oils, ingeniously manipulated, are substituted for most of the former uses of the whale oil. Nevertheless the North Atlantic, the North Pacific, Bering Sea, and the Antarctic regions still support a consider-

FISHMARKET AT GRIMSBY, ENGLAND.



STRIPPING BLUBBER.
Scene at a North Pacific Whaling Station.

able number of whalers who find the industry a profitable one. Whales have been reduced in number within the last century, by the persistent assaults of the hardy seamen, and it is fortunate that satisfactory substitutes have been found, or virtual extermination would have been their lot.

The most important commercial whale fisheries of to-day are in the North Pacific Ocean, Bering Sea and the Arctic Ocean around the Alaskan coast. Every year fleets of whalers spend the winter off Point Barrow, on the north coast of Alaska, in order to be ready for work when the ice breaks up in the spring. On these barren Alaskan coasts, the whale fishers of to-day establish their stations, in order to avoid the necessity of delaying their work on shipboard. These stations are usually situated in some sheltered cove, where great boiling vats are made ready. When a whale is killed it is towed close in shore, and kept afloat by barrels and buoys, while the blubber is stripped off for the boiling vats. A special gang of men attends to this part of the work, remaining on shore, and the vessel itself with sailors and whale hunters aboard, returns to the open sea to find more game. Such whale stations are odorous places at best, and their existence is betokened by great flights of gulls attracted from a long distance by the smell from the boiling vats, and the carcasses upon which the birds live in luxury after all the blubber has been removed.

EVENING'S HAUL OF SALMON AT A BRITISH COLUMBIA CANNERY.

It is a long distance from the whale fisheries of the Arctic to the sardine fisheries of the Mediterranean, but the taking of the little fish for table use is an industry not second in importance and not less interesting. Multitudes of fishermen around the Mediterranean coasts are busily engaged in the sardine fisheries, which are supplemented for the perfection of the industry by the olive groves along the same coasts, which provide oil for canning purposes. On the Californian coast, too, the sardine and olive oil industries are likewise developing together into commercial importance.

The southern coast of Alaska, British Columbia, Oregon and Washington are the sources of the immense product of salmon which now enters every market either fresh or canned. The salmon fisheries of the Columbia River and the adjacent waters are among the most important of the industries

MAKING TIN CANS BY MACHINERY FOR A GREAT SALMON CANNERY.

of our Pacific northwest. The scene in a great salmon cannery is a striking one, and by the rapidity and deftness of the processes, from the time the great fish is drawn from the water until it appears symmetrically canned and labeled for the market, it suggests no parallel but the packing house in our great stock yards.

On the other side of the continent, over the Grand Banks of Newfoundland, the hardy fishermen of the New England coast drop their nets and their lines for the enormous schools of cod and mackerel. This is one of the most picturesque of all the fisheries of the world, in the novelty of its methods, the bravery of the fishermen themselves and the perils of the work. Storms, fogs, and swift passenger liners speeding across the Atlantic, unite to threaten disaster to the Banks fishermen, but men rise to the demands upon them, and these very fisheries have bred a race of sailors known wherever ships sail, as unexcelled in courage, reliability and seamanship.

Another phase of the American fisheries is found in the inland waters of the Chesapeake Bay, where the oyster trade employs thousands of men in a pursuit more difficult and dangerous than is generally understood. The lobster industry on the Maine coast is likewise an important one, and rapidly increasing as this food increases in favor with epicures.

Inland fisheries lack some of the charac-

CLEANING FISH IN AN OREGON SALMON CANNERY.

LOBSTER PENS ON THE NORTH ATLANTIC COAST.

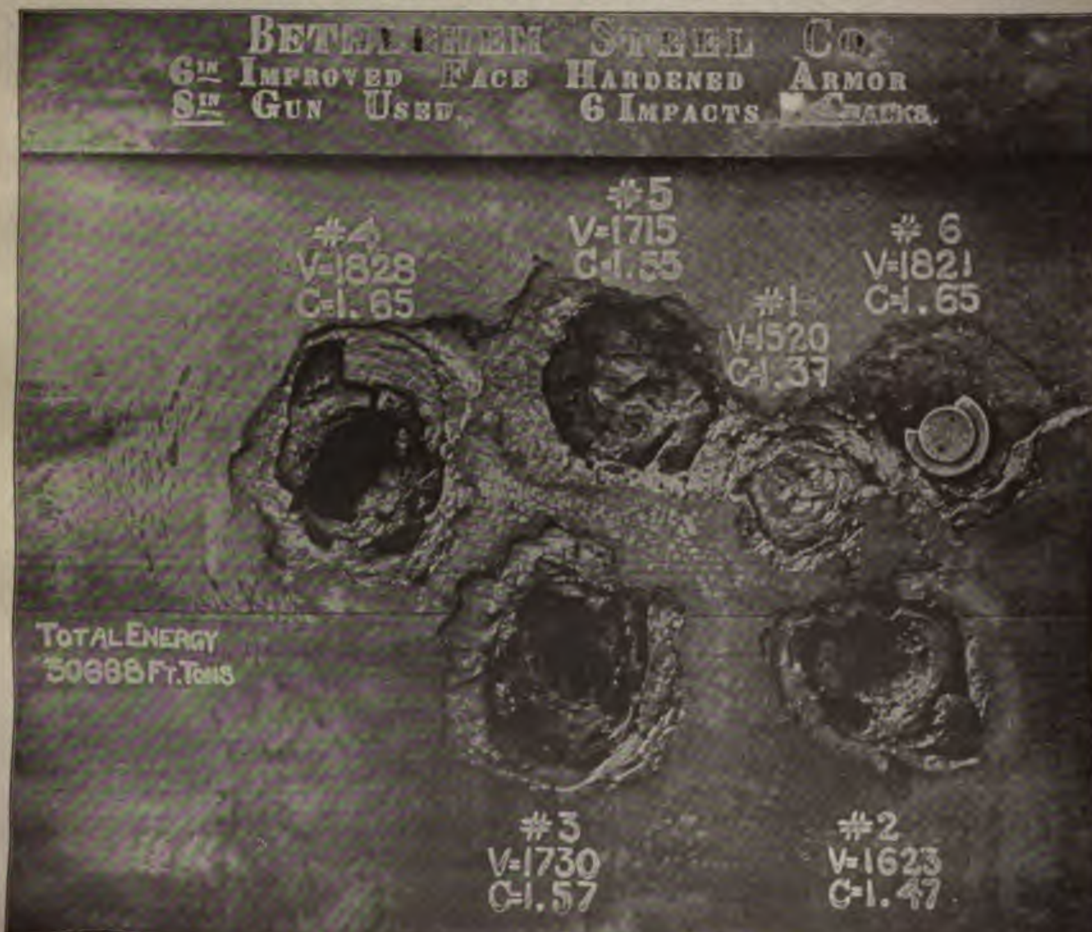
teristics of those of the ocean, but they have their own great commercial importance and do not lack picturesque features. From early spring till late autumn, hundreds of hardy men are busily engaged in the Great Lakes, chiefly in Lake Superior, to obtain the enormous quantities of whitefish and trout sold in every city and village.

There are river fisheries, too, of great importance, with the Mississippi and Volga as types of this department of the traffic. From the Volga, that greatest river of European Russia, comes most of the caviare which is a favorite delicacy on many tables. The only American supply which rivals it comes from the Lake of the Woods, on the northern boundary of Minnesota, where sturgeon fisheries, which produce the caviare, have grown to considerable proportions.

The maritime nations of Europe, which have a crowded population and a large proportionate sea coast, depend more upon sea foods than do we in the United States. Those countries facing the North Sea and the Baltic have developed fishing industries which are growing in magnitude. A large part of the product is consumed locally, but there is also a considerable shipment across the North Sea to the English markets. One of the most important receiving ports is Grimsby, where fishing vessels discharge their cargo for the markets of London and the other large cities.

GRAIN ELEVATOR ON CHICAGO RIVER. CAPACITY, 700,000 BUSHELS.

were made conical, and with a sharp point, having a fine temper, and the gun was rifled to give the projectile rotation and true flight, and the guns were made to load at the breech instead of the muzzle, adding greatly to the rapidity and facility of fire. Another inventor then came forward with a method of hardening the surface of the plate, by a process bearing his name. A Harveyized plate is so hard that it cannot be scratched with a file or cut with a cold chisel. Nickel was put in the plate, adding still more to its hardness and toughness. Then smokeless powder was produced, developing much greater energy than its black predecessor, and made to burn with accelerating combustion, and with it projectiles could be hurled with such velocity that the energy of their impact could not be resisted by the plate, and the gun had to be lengthened and strengthened forward to meet the new demands upon it. The limit in the weight of armor plate was soon reached. Twelve inches in thickness came to be about the maximum for the belt of the strongest warship, for she could not carry thicker and float. The projectile was still more improved, being made of the finest forged steel



TEST OF ARMOR PLATE FOR AN AMERICAN MAN-OF-WAR.

and tempered with great skill. Then came Kruppized plate, and the projectile was again turned aside or smashed upon its surface. Lastly a soft nose made of mild steel was placed on the point of the armor-piercing projectile, and the gunner could again laugh at the thickest Kruppized plate that could be carried by the battleship.

Contemporaneous with this work, the high-explosive manufacturer and inventor have been busy, but so burdened has been their work by popular misunderstandings of the nature of the high explosives, that they have had a much stronger barrier in the form of prejudice and ignorance to get through than has the gun manufacturer in keeping ahead of the armorer.

There was such a wholesale dread entertained by even rational investigators, and some inventors themselves, of high explosives, that they chose rather to theorize than to learn by experiment. It was believed by many that high explosives must of necessity be very ticklish, and that their sensitiveness must be in direct proportion to their explosive power. The word dynamite was sufficient to cause a person of average information to seek safety in flight from its vicinity. It was generally believed that if high explosives could only be thrown in any considerable quantity from guns they would destroy anything they might hit, or if they should strike in the water anywhere near a warship it would be sent to the bottom. But it was thought that guns must be constructed in some peculiar way, and a propelling means especially adapted to lessen the shock be employed for throwing some special kind of bomb, in order to get the dynamite out of the gun very gently.

THE FASTEST SHIP AFLOAT.
The British torpedo-boat destroyer "Viper," steaming at 38 knots, or more than 43 land miles, an hour.

The most notorious of these freaks in ordnance is the so-called pneumatic dyna-

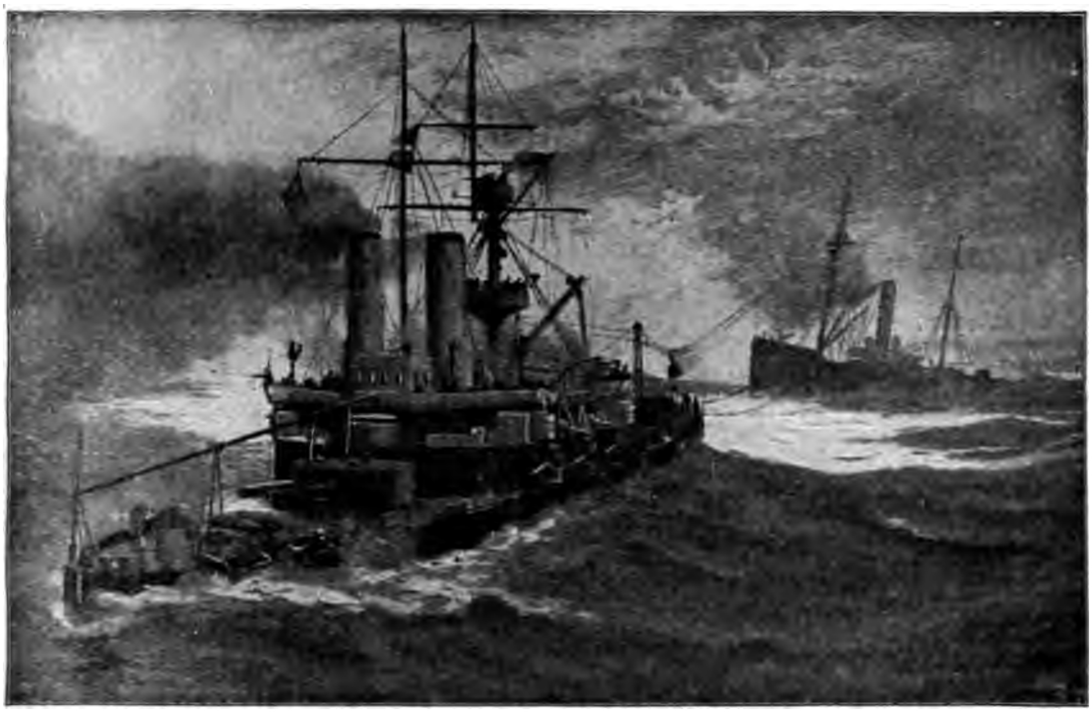
PRACTICAL EXPERIMENTS WITH NEW ARMOR AND PROJECTILES.
Gunnery practice against an obsolete battleship by our North Atlantic Squadron.

mite gun, a battery of which guns was erected at Sandy Hook and protected at great expense, and a similar battery was put up at San Francisco. The expense of these outfits was enormous, and absolutely to no purpose whatever. Their range is limited to about a mile and a half. The projectile has no power of penetration whatever, and must necessarily go off on impact outside of an object, should the gunner be so lucky as to hit anything with it; but the angle of fire is so high, and the range so short, that the question of hitting an enemy's battleship with one of these weapons can be no longer seriously considered. A fleet of modern battleships could lie with perfect safety within close gunshot of these batteries and bombard them out of existence, and it would be impossible for the pneumatic guns to get a single shot within half a mile of any of the battleships.

In 1899 Gen. A. R. Buffington, the Chief of Ordnance of the United States Army, determined to thoroughly investigate the subject of high explosives, and he arranged that the Ordnance Board, with headquarters at Sandy Hook Proving Ground, New Jersey, should carry out a line of experiments in such a thorough and efficient manner as to settle once for all what known high explosives were the most suitable for use in the service, and also to test thoroughly

PLACING A BIG GUN ON BOARD A BATTLESHIP.

This extraordinary gun, 36 feet 8 inches long, has a range of 14,000 yards, or eight miles. It fires a shot weighing more than half a ton with a charge of 650 pounds of powder.



COALING A BATTLESHIP AT SEA.

and without partiality, any and all new high explosives which might be submitted by different inventors and manufacturers, provided they appeared to offer sufficient merit to warrant investigation.

MAXIMITE, THE NEW EXPLOSIVE.

Maximite, which was adopted by the Government, satisfactorily stood every test to which it was subjected. It is very inexpensive of manufacture; has a fusion point below the temperature of boiling water; cannot be exploded from ignition, and, indeed, cannot be heated hot enough to explode, for it will boil away like water without exploding. It is, therefore, perfectly safe to melt over an open fire for filling projectiles, in the same manner that asphalt is melted in a street caldron. Should the material by any chance catch on fire, it would simply burn away like asphalt, without exploding. When cast into shells, it not only solidifies into a dense, hard incomprehensible mass on cooling, but it expands and sets hard upon the walls of the projectile like sulphur, that is to say, in the same way as water does in freezing.

Hiram Maxim, the inventor of this explosive, describes its effects as follows, and adds his opinions on the tendencies of modern warfare: "When a shell filled with it strikes armor-plate, the Maximite does not shift a particle, and it is so insensitive that it not only stands the shock of penetration of the thickest armor-plate which the shell itself can go through, but it will not explode, even if the projectile breaks upon the plate. In one experiment a six-pounder projectile, filled with Maximite, fired against a thick plate, entered the plate about half its length and upset—that is to say, shortened nearly two inches and burst open at the side, and some of the Maximite was forced through the aperture and the projectile rebounded from the plate about 200 feet and struck in the front of the gun from which it was fired, and all without exploding. Some lyddite shells—that is to say, shells charged with picric acid, the high explosive adopted by the British Government,—filled in the same way as was Maximite, into the same kind of projectiles and fired at a thin plate an inch and a half in thickness, all exploded on impact. So insensitive is this high explosive that melted castiron may be poured upon a mass of it without causing an explosion. The writer has repeatedly made this experiment. When a projectile, however, charged with Maximite, is armed with a proper detonating fuse, such as that used in these experiments, the invention of a United States Army officer, it is exploded with such terrific violence that a 12-inch armor-piercing projectile was broken into at least 10,000 fragments; 7,000 were actually recovered. This armor-piercing projectile, weighing 1,000 pounds, was filled with seventy pounds of Maximite, armed with a fuse, and burned in the sand. After exploding, the sand was sifted to obtain the fragments. There were other high explosives tested with Maximite, which also produced remarkable results. Had not Maximite been invented, the Ordnance Board would still have in its possession a high explosive developed by the Army Department itself, far superior to anything that has ever been employed in any other country, and the work of that Board for the last two years would have still been highly rewarded. Maximite has been adopted for the sole reason that it fulfills the largest number of the highest requirements sought for by the Ordnance Board."


FACTORY FOR HIGH EXPLOSIVES, SHOWING EARTHEN WALLS, TO PROTECT AGAINST DISASTERS.

Not since the lesson taught by Ericsson's Monitor has anything been accomplished in military science more pregnant with meaning than these results at Sandy Hook. They have demonstrated that nothing whatever can be made to float with armor which will be capable of withstanding the destructive effects of Maximite shells thrown from modern high-power guns, which are capable of penetrating the thickest Kruppized plates, to explode into a battleship.

Should the United States now become involved in war with any other great power, we should be able to throw these high explosive projectiles through the thickest armor of our enemies, to explode inside their warships, while they, in turn, would be able to penetrate our armor with solid shot, or, at least, with projectiles carrying no bursting charge whatever.

Mr. Maxim also says: "The moral taught by these new developments is that the ponderous battleships must go and be replaced by the small, swift torpedo boat or torpedo gunboat and cruiser, and practically unarmored, as no protection whatever can avail against such missiles. There must be no sacrifice of mobility for cumbersome armor. While Maximite places this government far in the lead of any other power in its weapons of offense and defense, it will, as well, save this government many hundreds of millions of dollars which should otherwise have been expended in the building of unwieldy battleships, for which other powers have squandered fabulous sums, and which must soon be recognized as obsolete. The competition between the great powers for naval and military supremacy is about as keen as it could be in an actual state of war, and the drain upon their resources is enormous, and the burden year by year is growing heavier. It is problematical whether England, France or Germany would prove the stronger in the event of war, and it is equally problematical which can longest endure the ever increasing drain upon its resources as a measure of insurance in the event of hostilities. And there is another problem—and one of vast concern—and it is whether these stupendous preparations are altogether wise on present lines; but no power dares to deviate too far from the main course pursued by the other powers for fear of making an irreparable mistake, and so big battleship building still goes on, with a sort of half-awakened consciousness that these craft will prove a source of weakness rather than of strength.

"Along with the ponderous, armor-clad battleship, we have seen developed means for its destruction, so that to-day it holds no higher place with respect to invulnerability in face of these means, than did the wooden hulk of a half century ago in the face of the weapons then used. Indeed, it is probable that the modern battleship, costing five or six millions of dollars, will be in still greater danger of being sent to the bottom in a modern naval engagement than was the wooden craft of Nelson's time.

"Let us consider what will be the chief forces that will oppose the battleship and oppose one another in the next great naval engagement. First, there will be the torpedo boat and the torpedo boat destroyer, capable of traveling at a speed double that of the battleship, armed with Whitehead automobile torpedoes, which launched below the water lines will run beneath the surface as straight as an arrow to deal the battleship a fatal blow below its armored protection. There will also be the submarine boat, similarly armed, which has already shown itself capable of stealing upon the battleship wholly unobserved, to deal it a deadly blow, even in the glare of noon, as well as at the dead of night. And there will be another form of torpedo craft, armed with automobile torpedoes, which will run upon the surface of the water like an ordinary torpedo boat, but at railroad speed, and which will dive to a semi-submerged position when coming within the range of the enemy's guns. Half a dozen torpedoes will be launched by it in a moment, and the little boat will be endangered only by the huge vortexical gulf down which the battleship takes its plunge to the bottom of the sea.

"Now that a high explosive has been developed, which is capable of withstanding the shock of penetration of the hardest steel wall of the biggest armor-clad, to explode in vital parts, the battleship has another and most formidable antagonist. By means of this invention the destructiveness of the present high-power gun is enormously increased. There will be two systems of guns and projectiles employed—the one the present quick-firing, high-power cannon, throwing armor-piercing projectiles carrying relatively small bursting charges of high explosives, to explode on the interior of the warship, or within the armor, to rip it from the sides. The other will be the torpedo gun, throwing aerial torpedoes carrying half a ton or more of high explosive at high velocity, to explode and crush the walls of the battleship or demolish its superstructure, or, if falling in the water, to crush in the sides below the armored belt. Each of these systems will have its advantages over the other, and will also have its disadvantages. While the large quantity of explosive carried in the aerial torpedo will be capable of working wide destruction when landing fairly on the mark, yet the quick-firing cannon, with equal range, and able to fire many times as fast, with projectiles capable of penetrating the strongest armor, to explode inside, will remain no mean rival to the torpedo gun, and any and all other forms of attack.

ARMORED BOAT FOR RIVER SERVICE IN CENTRAL AFRICA.

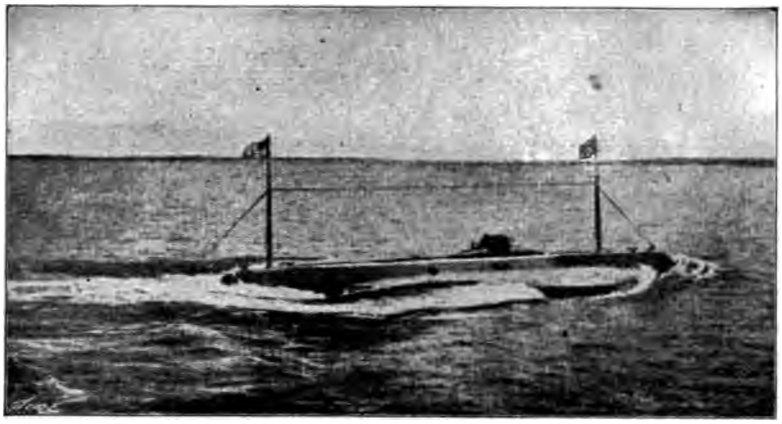
NAVAL BATTLES IN THE FUTURE.

"The first and most important lesson which will be learned from the next great naval battle will be that armored protection will not protect, and the fight will soon be a duel between battleships at long range, aided by various forms of torpedo boats, and light unarmored cruisers, throwing high explosives; and these latter will be the factors which will determine the fight. The heavy armorclad will be discredited, and then will be a wild scramble by the nations in the endeavor to make up for the lost time wasted on its construction, and light and very swift unprotected war vessels will be constructed, depending for their safety upon their speed, and upon their own ability to strike death-dealing blows. These are the true principles which must, sooner or later, be recognized.

"The British Government now proposes building still larger and heavier battleships and, of course, enormously more expensive. Within the next decade, and sooner, in the event of the great war, this will be learned by the British War Office to be a great mistake. The writer pointed out some years ago that the introduction of gunpowder was long opposed on grounds which, according to twentieth century ideas, are supremely ridiculous. To us moderns nothing could be more apparent than the superiority of firearms over bows and arrows as weapons of war. A few years hence, the present panorama of the nations will appear ludicrous, vying with one another for naval and military supremacy, and exhausting their treasuries in the construction of huge battleships, a dozen of which will be [illegible] by a torpedo fleet costing no more than one of them. Such battleship destroyers are now an accomplished fact, and lie under the eyes of all the world to-day, but are not [illegible]. These words are told into ears that [illegible]. It is like knocking at [illegible] house for admission. Only the issue of a great naval battle can bring the torpedo fleet into proper recognition.

"When firearms were first introduced, the foot-soldier was clothed in armor, which was constantly increased in weight and thickness to resist improved weapons, until it became so ponderous and unwieldy as to sadly interfere with mobility. It was found impossible, however, for the soldier to carry armor thick enough to protect him against missiles hurled by gunpowder. As a result, all the armor was discarded. The modern war vessel has now entered upon a similar phase of its evolution, and for exactly the same reason that the soldier was obliged to discard his armor, so will armor have to be sacrificed in the coming war vessel, and the most practical means of defense will then be found to consist in the very means which serve best for offense."

The naval authorities of most of the maritime powers have studied with great interest the progress of experiments in submarine craft. Inventors for years have been endeavoring to perfect vessels that could be submerged and still propelled and controlled with safety to their occupants. This series of investigations has been encouraged by the governments with some spirit of rivalry as to which country should first obtain such a practicable craft. In our own country the vessel known as the Holland, named for its inventor, has achieved remarkable success and has been adopted by the government as a worthy adjunct to our coast defense. The vessel travels at fair speed on the surface, may be submerged for several hours without discomfort or danger to its crew, and can travel slowly under water, so that it may advance clandestinely upon an enemy with-



THE "HOLLAND" AT FULL SPEED ON THE SURFACE.

out danger of discovery. For launching torpedoes against the side of a battleship without danger to the attacking party, such craft have every advantage. They have not been perfected yet to a degree that enables them to make long voyages, but the present success is sufficient to promise great improvements in the future.

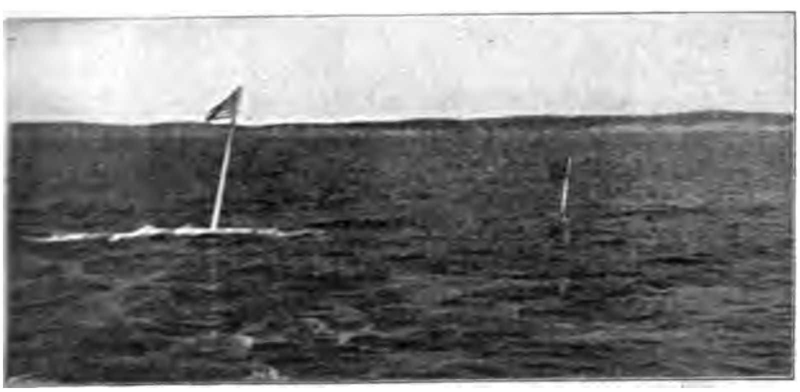
THE SUBMARINE VESSEL.

The French experiments have been successfully achieved through the skill and genius of Gustave Zádé, an inventor of Toulon, who has built two interesting craft of which the latest, named for himself, is the most successful. This latter boat is 147 feet long and is propelled by electric motors with storage batteries. The hull is cigar-shaped, with very sharp ends, and the speed is eight-and-a-half knots an hour below, and fourteen knots above the surface. A crew of ten men is carried, with compressed air, stored in tanks, enough to last them while below. Torpedoes may be discharged from an opening in the bow of the boat. This vessel has been operated in deep and shallow water with remarkable success, and has made trips up to seventy miles without difficulty. All of these submarine craft are operated on the same general principle, being sunk by admitting water to tanks provided for the purpose, and raised to the surface again by the buoyancy of these tanks when the water is pumped out.

For warfare in the interior of uncivilized countries, the light-draft armed vessel also has been brought to a high degree of adaptability. The British in Africa use what they term an armored canoe, although the word canoe is a misnomer. It is a heavy steam launch, covered with boiler iron, and with shields to protect the men and the rapid-firing machine guns which it carries. Such a boat can penetrate the African jungles by way of the rivers and can assist in campaigns against savage tribes who could with difficulty be reached at all by the trails through the forests. The United States, like other powers, utilizes light-draft gunboats for service in the rivers and archipelagoes of the Asiatic coasts, and the Pacific islands where such service is needed. The rivers of China and Korea, at the time of native attacks on foreigners, have been the frequent scene of such operations.

In order to still more facilitate the operations of warships at sea, a device has been invented by which the fighting craft may take coal without making port. Wire cables are strung between the masthead of the battleship and the collier, and upon these cables iron baskets are hauled back and forth until the coal is transferred. This is an application of the trolley system by which ore and coal are conveyed from mines to cars for shipment, where valleys and hills intervene. Experiments with this method of coaling have been made in the American navy and in the British navy, and in moderately rough weather forty tons per hour have been taken aboard a battleship from a collier. With practice it is believed that this speed can be greatly increased, and such embarrassments as hampered the American navy in the Caribbean during the late war will be eliminated.

The improvements in the appliances of warfare thus briefly indicated are typical of others upon which students of the arts of war are engaged. In these ante-millennium times, war is occasionally a necessary contingency, and when it comes we want the best tools we can get to fight with.



SUBMARINE BOAT "HOLLAND" DIVING.

It is a crime for a nation not to be prepared for war, a crime against those who will be called upon to defend her in time of war. It is a crime for a nation not to abreast of the times in arms and equipment. At best war is cruelty, but it is not often a necessity but unavoidable, and, engaged in, should be made as destructive as possible, in order that it may be brief as possible, thus minimizing the evil in the aggregate.

The approximate dates of the completion of the new battleships and cruisers of the United States were given by the Secretary of the Navy at the beginning of 1902 as follows: battleships: Maine, October, 1902; Missouri, March, 1903; Ohio, May, 1903; Virginia, May, 1904; Nebraska, July, 1904; Georgia, July, 1904; Rhode Island, July, 1904. Armored cruisers: Pennsylvania, January, 1904; West Virginia, February, 1904; California, August, 1904; Colorado, January, 1904; Maryland, February, 1904; South Dakota, August, 1904.

With the completion of the above, the navy will have seventeen battleships and eight armored cruisers. The total number of warships of all kinds under construction at the same date was fifty-nine, including besides those mentioned, nine cruisers, four monitors, twenty-five torpedo boat destroyers, nine torpedo boats and seven submarines. In addition to these, the navy in commission at the same date included eleven men-of-war of the first rate, meaning above 8,000 tons; fifteen of the second rate, or between 4,000 and 8,000 tons, and about eighty of less size, including monitors, cruisers, gun-boats and torpedo boats. The best calculations therefore credit the United States with being fourth among the powers in naval strength, surpassed only by England, France and Russia, and followed by Germany, Italy and Japan.

FLOATING DOCKS FOR MEN-OF-WAR

The immense increase in the size of men-of-war in the last few years has compelled the rapid increase of repair and supply and equipment stations wherever such vessels are to sail. The navy without proper equipment would be as bad as no navy at all, and so every country has found it necessary to seek a favorable location for coaling stations all over the world. In time of war, the fighting ships of the hostile powers are limited in their privileges in neutral ports. For instance, they are permitted to take on board only sufficient coal to enable them to steam to the nearest port of their own country, and that privilege can not be duplicated at a later time during the progress of hostilities. Powerful and threatening as a great battleship is, there can be nothing more helpless than such a craft either out of coal or disabled for want of some facility of repair.

The prime requisite for well-equipped navy yards is a dock in which even the largest vessels may rest while they are being overhauled. There are two types of such docks, the drydock which is built on land, with gates by which the water may be admitted and released at will, and floating docks, for use where the other type is not available. Like other powers, the United States has found it necessary to extend its docking facilities, and the great structure pictured herewith is the newest one of all. This floating dock is located at Algiers, across the Mississippi River from New Orleans, although such craft may be taken from port to port at will. In the illustra-

FLOATING DOCK SHOWING BATTLESHIP ILLINOIS IN PLACE.
This dock was built by the Government for use at New Orleans.

LAUNCHING A GREAT FLOATING DOCK.
This dock was constructed at Wallsend-on-Tyne, for use in Bermuda.

tion, the new battleship Illinois is seen in the dock high out of the water.

In spite of the great size of the floating dock, the method of its use is simple enough. The general shape of the peculiar structure, if it were cut right through to show a section, is that of a great letter U, but on the outside it is rectangular, the curve of the U occurring only on the inside. The great bottom and sides of it are hollow, and under ordinary circumstances it floats high on the water. When it is desired to take a vessel into the dock, the great pontoons, which are enclosed in the bottom and the lower part of the sides, are pumped full of water, so that it sinks to whatever depth is required to permit the admission of the ship. With the end gates open, the ship is now moved cautiously into the dock, and braced in place, after which the water is pumped out of the pontoons. As the dock rises, of course the vessel rises with it, until at last it is entirely uncovered and ready for whatever repairs are necessary. In order to release the ship from this position, the same process is reversed. In the picture, one obtains a striking view of the bottom and bow of the Illinois and its projecting "ram." The peculiar trusses extending from the side of the dock to shore are hinged at each end so that although the dock may rise and fall with the tide or the weight of vessels, it still maintains its position in reference to the shore. Another new floating dock which came into service for the American navy is the one at Havana, which was built at Birkenhead for the Spanish Government in 1887, and cost nearly $600,000.

The other illustration shows the launch of a new floating dock constructed in England for use in Bermuda. This dock is 545 feet long, the side walls are fifty-three feet high, and the total width of the structure is 130 feet, with 100 feet between the walls. This dock is capable of lifting out of the water a ship 17,500 tons in weight, and drawing thirty-two feet of water. This dock cost $1,150,000, of which $175,000 measured the cost of towing it across the Atlantic Ocean to Bermuda.

THE FIRST CABLE ACROSS THE PACIFIC OCEAN

Now that the political and commercial sway of the United States extends far into the Orient, it is necessary to connect the nation with its remote dependencies by steamship lines and submarine cables under our own control, so that communication may be uninterrupted at all times. Steamship lines, in fact, are already established between the Pacific coast of the United States and our island possessions of Hawaii, Samoa, Guam and the Philippines. In order to accomplish the other purpose, Uncle Sam is about to spend 9,000,000 good American dollars for copper wire, gutta percha, jute yarn, tar, and steel wire. When this money has been spent and a fleet of ships and a thousand electricians and engineers have finished their work, the Philippines and the United States will be within half a minute's talking distance of each other.

The cable which will establish this communication will be the first to span the Pacific, and almost triple the length of the longest submarine wire ever laid. From San Francisco to Manila, with stops at Guam and Honolulu, the distance is nearly 8,000 miles.

The making of this great stretch of cable is a colossal task. About 22,740 tons of material will be required—1,980 tons of copper wire, 12,000 tons of steel wire, 2,300 tons of jute yarn, 4,300 tons of compound and tar, and 1,260 tons of gutta percha. This means a total weight greater than that of forty-eight locomotives of standard size.

Most people know in a vague, general way that the submarine wire is about an inch thick, and that it resembles, more than anything else, the underground cable which in some cities operates the cable cars. Few people, however, have any idea of the inner construction or of the ingenious processes by which the delicate copper wires that carry the electric current are so protected that they lie for years and years on the oozy bed of the ocean, and do their work with practical immunity from breaks, accidents or interruptions of any kind.

The cable is composed of three parts: the copper strand; the hemp, tar and rubber casing which protects them from the water, and the heavy steel binding that acts as a shield against rocks, wreckage, the keels of ships, and the sharp teeth of ocean monsters.

The first step in the making of a submarine cable is the preparation of the copper wire. After the wire has been weighed and tested it is taken to the winding drums. Here it is rapidly reeled around large, spool-like devices called bobbins. From the winding room the wire goes to the stranding room. Here the seven wires are twisted together and united on the cable stranding machines.

The thin metal threads which are destined to flash under the water messages for which, perchance, a world will wait breathless, are now ready for their first sheathing. This consists of insulating material, jute being usually employed.

In applying the jute water is used, and as the least moisture would render the cable useless, a very careful and thorough system of drying is employed. The jute-covered wires go through vacuum drying-boxes,

ɜ last vestige of moisture. ɔoxes the wire passes to th insulating material. llowed to steep until the ıe so thoroughly impreg- no chance of any of the ıking out, after the cable ɔonsigned to its watery e first stage of the work

ɜ making of the gutta ·spite its great cost, gutta l in the Pacific cable, for . to give a better result m of casing. From time ıufacturers have utilized ·mpounds as substitutes. be vulcanized by heating h sulphur or some sul- ı, to deprive the rubber lities. Even at their best er compounds has been ta percha.

ıtta percha the mass of ıl is first heated and ial process, till it becomes ·ned, pliable heap is then , where it is to be united ıble wire. By the use of ıe gutta percha is deftly e strands in the form of Here again the greatest ave the covering air-tight f; for the least drop of way into the wire would ɜ results.

consisting, at the present uction, of the copper wire and gutta percha cover- ·ollers, partly through the ·tly through a long tank The purpose of the latter is to harden the gutta percha. The cable is then subjected to a final rigid test, and if the insulation is perfect it passes to the armaturing department. The second stage is finished.

The third and final process is administered by the armaturing machine. To this powerful contrivance is allotted the task of putting on the shield of steel wire. The big machine works with an almost human intelligence and handles the heavy ropes of steel wire as deftly and as easily as a sewing machine manipulates threads of cotton. Over the metal casing is spun a protecting fibre, which is then impregnated with insulating material. It is the purpose of this insulated fibre to protect the armature from the destroying effects of the earth and water. After being drawn through a bath of lime water, which destroys the adhesiveness of the impregnated fibre, the cable is wound upon large wooden rolls and is ready to be taken on shipboard. In so far as human genius can make it so, the cable is protected against any injury from the elements or the denizens of the deep.

Much of the work preliminary to the laying of the cable has already been done. The United States ship Nero has taken probably a thousand soundings to determine the depths and character of the bottom from our western coast to the Philippines.

Four vessels, each having cable tanks forty feet in diameter and holding about 1,000 miles of cable, will do the work of handing over the wire to old Neptune's embrace.

When the cable is finished, a greater step toward the pacification of the Filipinos than the despatching of regiments of soldiers will have been taken. Through ready communication the natives can more

UNIQUE NOVELTY IN HOTEL CONSTRUCTION.

RON AND STEEL INDUSTRIES

rial from which this its marvelous machin- ıgs, its railways and it is, upon which our 'e built their fortunes, all wealth in the his- The steel trust, it is, h has done more than ıence to draw the at- at large to the enor- f capital for the dom- rial world, not alone ›ver the globe. So it becomes of prime interest and importance to observe the progress of the industry and its products from the mine to the consumer.

There is a wide distance between the primitive miner and molder of prehistoric times, with his rough furnace, his rude appliances, and the customers of his neighborhood, and the remarkable organization of mines, transportation facilities and manufacturing plants which now unite to form the great iron and steel interests. The United States Steel Corporation, as the trust is officially entitled, with its capital

Photographic Co.

ORE DOCKS AT ASHTABULA, OHIO.

of the tin plate. The annually approaches a value of more than teel output is nearly he total value is about furnaces, rolling mills y variety help to bring The crude iron ore as ines is taken through esses, until it becomes for use in complicated building, or for rail-

ies from the mine is k, sand and other min- must be removed, and s is that of pig iron, y. There is a melting eat cupola, cylindrical in shape, standing erect like a huge vertical boiler and lined with fire brick. A coke fire is started in the bottom of the cupola, and on top of the fire is dumped a mass of iron ore, alternating with lime and coke. There is a blast pipe below, through which a strong draught is driven, and a stack above from which the smoke and gases escape. The metallic iron melts out of the ore by the action of the heat, stimulated by the blast, and the lime takes up such impurities as cannot be removed by the heat itself. The metallic iron, melting, runs to the bottom of the cupola, where it accumulates in a liquid mass. The floor of the great room is made of sand, in which long troughs are marked, connecting with a main channel. When the iron is all melted in the cupola, a spout below is suddenly

NGOTS" AND "BILLETS" READY FOR MANUFACTURERS' USE.

lten mass flows out in a
hese troughs of sand it
is broken off into proper
ient handling. This is

sticking up from its chains. This passes it into the grip of a succession of great rollers, through which it is squeezed like a wet cloth through a laundry wringer, continually increasing in length and diminishing

MAKING CAR WHEELS—MOLDS READY FOR POURING.

mplete manufacturing
convert their iron into
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steel converting crucible.
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s is complete to produce
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l is now a steel ingot.
ed for railway rails, the
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or bed, with projections

otherwise. At last it takes familiar shape, and in a few hours from the time it left the cupola, becomes the finished railway rail.

OPENING THE MOLDS.

...OAL MINING AND COKE MAKING

...e earth, thousands upon ... are working day and ...oal which is an essential ...e industrial activity of ... the new forms of power ...vised by ingenious in...rs, it has not yet proved ...te or even to reduce the ...ic power, except in those ...where it is generated by ...uires, somewhere, that ...d boilers shall be em... instance. Electric light ...rsede gas, and so reduce ...n- ...li- ...al ...to ...er ...y- ...g ...s ..., ...-

prises and the extension of railways has been a factor of prime importance in the coal trade of recent years.

Cautious scientists more than once have expressed alarm over the threatened exhaustion of the world's coal supply. And yet it appears true that the economical utilization of coal by improvements of power applications, will more than counterbalance the increased consumption of the essential fuel, and that after all nature will preserve a balance in some way. Great areas are known to exist where coal is plentiful, hardly yet touched by the miner's hand. Siberia and the Chinese Empire are noteworthy examples of this. Petroleum fields, yielding apparently limitless quantities of fuel oil, have been discovered in many parts of the world, and except on the shores of the Caspian Sea have been made use of hardly at all. Texas, the Mexican peninsula of Lower California, Central Siberia, the East Indies, and the mid-Australian desert, come into this category. Such natural forces, eternal and world wide, as the winds, the tides of the ocean and the

COAL MINER WITH SAFETY LAMP.

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into the earth as some in the old world. The deepest coal mine known is near Tournay, Belgium, extending 3,542 feet into the earth. The deepest coal shaft in England is in the Dunkirk mine of Lancashire, which measures 2,824 feet.

Pennsylvania so far leads all other states of the union in its production of coal that a description of the industry there will serve to characterize it throughout the coun-

DOWN IN THE TUNNEL OF A COAL MINE.

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try. Its total product is always more than half that of the entire American yield from all the mines, and exceeds annually 105,000,000 tons. So commanding is this industry in the Keystone State that the popular mind always associates the state and the product, and Pittsburg has gained the name of the Smoky City, thanks to the great manufactories and mines operating in its vicinity.

Coal was discovered in the Schuylkill di-

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nt levels, so that

work may be carried on in many places at the same time. Tracks are laid in all these tunnels or drifts, and on these, little tram cars run back and forth, to carry the coal to the surface. When they reach the shaft, they must be hoisted by powerful machinery on the outside.

In European mines, women and children are often employed to push these cars back and forth, but in the United States, horses and mules are used. Even these in some mines have been superseded by locomotives, operated by compressed air. Such locomo-

A GREAT COAL "BREAKER."

h which coal passes on its way from mine to railway car. By screens
es it is cleaned and sorted into various sizes for market.

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tanks, from nozzles connected with high-pressure pneumatic tubes placed at the points convenient for the purpose. Such a locomotive can draw long trains of cars, of which the mule can handle but one, and at much faster speed. It is thus that mechanical inventions are steadily improving the industrial processes in almost every line of business.

When the coal reaches the surface, either by tunnel or by shaft, it passes rapidly through a series of processes necessary to clean it, sort it into the various sizes or grades for the market, and bring it to the railway cars by which it is to be shipped to the place of sale. A great coal "breaker," as the peculiar structure is called where these processes are carried on, is a place of dust and noise, of rambling sheds, inclined

COAL FROM MINE TO MARKET.

n striking manner a general view of a mine, including the entrance to the eaker, and the loaded cars ready for shipment, with the miners' houses in the background.)

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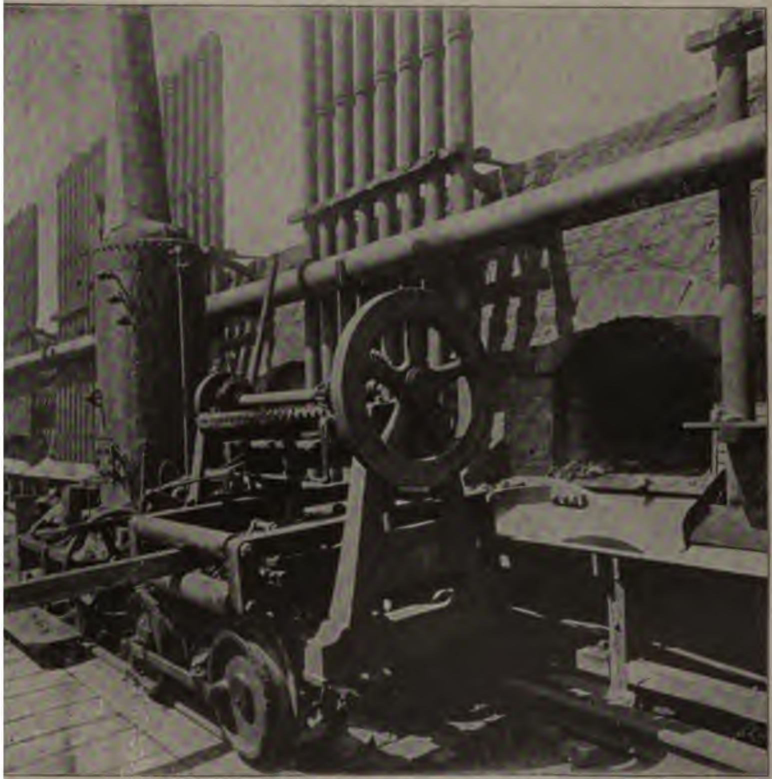
portant aid in the traffic. Barges loaded with coal are lashed together, to form immense flotillas which are towed down stream on the Ohio, to such other markets as can be reached to advantage by that route. Ohio, West Virginia, Kentucky, Indiana, and indeed the whole of the Ohio



DEVICE FOR REMOVING COKE FROM OVENS.
(The rake-shaped fixture draws the charred coke out of the oven and into the trough, whence it is delivered as described in the accompanying view.)

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and Mississippi Valleys, share in this distribution of the Pennsylvania product.

A very large part of the Pennsylvania coal product is converted into coke for use in the steel mills and manufactories where it is needed. The coke furnaces thus become a feature of the coal industry, and they have grown to immense proportions because of the demand of the steel trade.

OTHER PRODUCTS OF THE MINES

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The rapid increase in the demand for electrical appliances of all sorts has increased in like measure the value and the need of zinc which is used so much in electrical mechanics. This has resulted to the profit of the zinc miners, in like degree as the copper interests have profited from the same cause. The enormous copper mines of northern Michigan, Montana and Arizona have multiplied in the value of their output within recent years, thanks to the demands of electricity in its various uses. The annual production of copper in Montana approaches $30,000,000, and the other producing states named are not far behind. The total annual value of our mineral products equals $650,000,000.

A ZINC MINING SCENE.

E CITY "SKY-SCRAPER"

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buildings many times as tall as the tallest factory chimney a few years ago. The "sky-scraper" has its distinct place in modern city building, and its name is happily descriptive of its characteristics. The phrase-makers have been busy with this modern giant. The inhabitants of the tallest buildings are popularly known as the cliff-dwellers. One apt critic has likened the narrow streets thus overhung to the canyons of western rivers, worn by erosion through the ages, to a level far below the natural surface of the country. In this comparison the busy traffic upon the streets below becomes the eroding stream, and the walls of brick and stone the rough sides of the canyon.

Leaving these apt comparisons for the more practical, we find that apparently there is yet no limit to the height of the city sky-scrapers. Chicago was the pioneer in their construction, and today some of Chicago's streets are almost lined with splendid structures of this type. But New York has outstripped Chicago, while every large city from the Atlantic to the Pacific has its quota of these architectural innovations, and they are no longer a novelty.

It is hardly more than fifteen years since the first sky-scrapers, the Montauk, the Tacoma, and the Owings buildings, were erected in Chicago, and now their twelve-story limit seems low indeed in comparison with the multitude that have succeeded them. When they were begun no one prophesied that others more than twice their height would follow within ten years. And yet they were a result of conditions that have been forming for many years.

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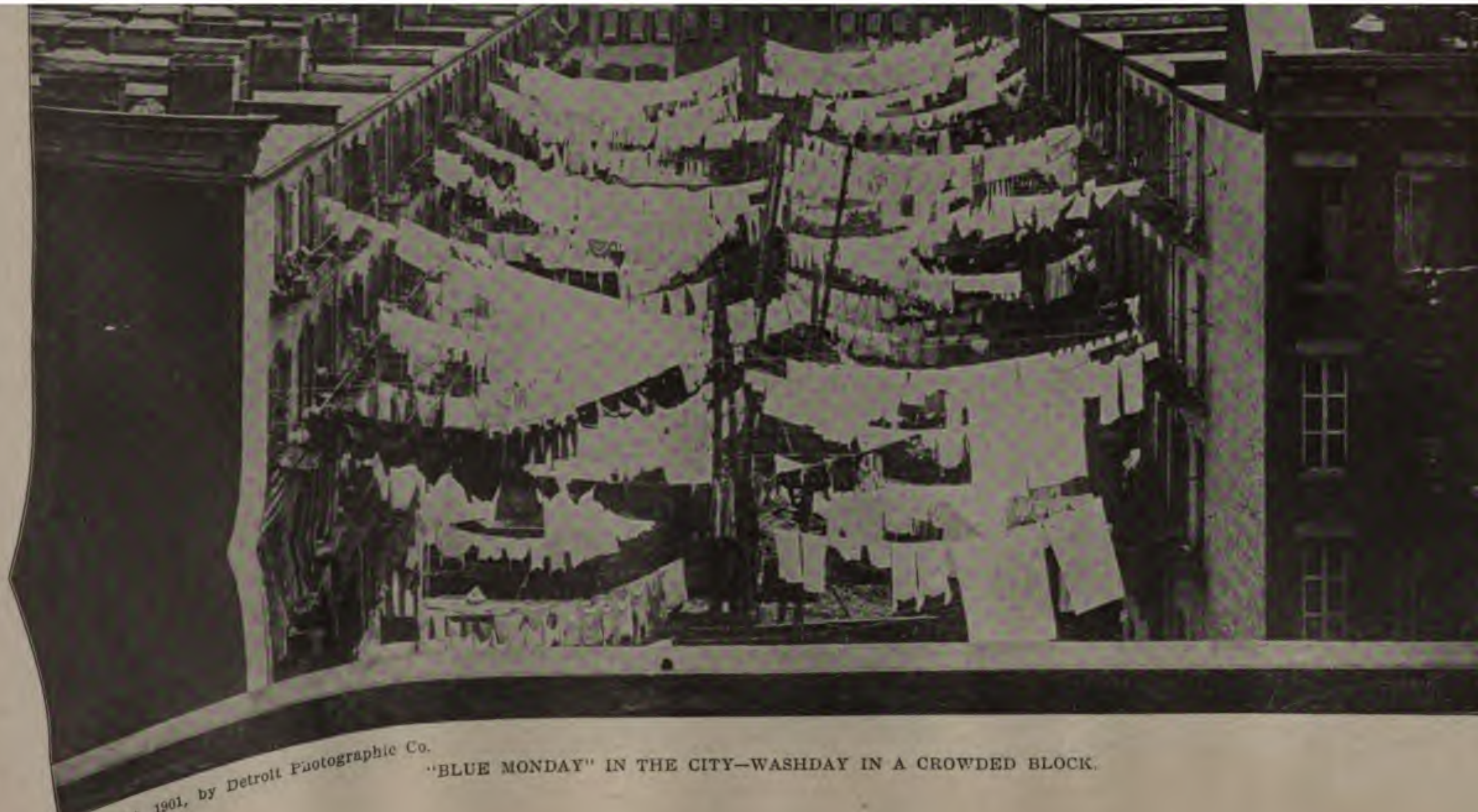
framework, braced and bolted together untii it stands like a skeleton, clad only on the surface with the brick or stone facing for its flesh. Such a framework, properly built, can no more be shaken down by an earthquake than can a birdcage. And the masonry itself, supported independently by the steel beams of each floor, is not required to maintain its own weight from the bottom. This is a great economy of light and space, to mention only one detail. Under former methods the walls had to be thicker at the bottom, the taller the building was to be. And for a very high structure such walls

raphic Co.

"NEWSPAPER ROW," NEW YORK CITY.

left is that of the New York World. The one in the center, with the building. Between them, the little old-fashioned structure is the the Sun. At the right of the picture is the Times building.

ELPHIA SKY-SCRAPERS AT BROAD AND CHESTNUT STREETS.



"BLUE MONDAY" IN THE CITY—WASHDAY IN A CROWDED BLOCK.

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FOR GREAT SSES

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Andrew Carnegie, the great ironmaster whose benefactions to the cause of learning have made him conspicuous in directions outside of his industrial undertakings, declared in an estimate of himself that he had prospered largely because he had the discernment to surround himself with loyal employees who knew more than he did. Whether Mr. Carnegie intended this lightly or not, the merit of the expression can not be denied. The ability, the strength and the time of one man, however brilliant, could not be expanded to encompass the manifold obligations of the enormous commercial and financial and industrial undertakings of to-day.

An accompanying illustration shows the interior of the largest office in the world, the business office of one of the great packing-houses at the Chicago Stock Yards, whose operations are described elsewhere in this volume. This illustration, made from a photograph, indicates more clearly than words can do, the size of such a business concern. No argument is needed to suggest that only by the most perfect organization and subdivision of duties could such a business be carried on without great waste of time, labor and money. Here a thousand clerks, bookkeepers and other employees work in a single immense room, carrying on the business of the plant which operates nearby and deals with the whole world. So it is with great railway consolidations, great banks, wholesale houses and other forms of modern commerce and industry. Those which organize most perfectly to forbid waste and to utilize all their resources and energies are the ones which achieve conspicuous success.

: STREET LIFE IN A GREAT CITY

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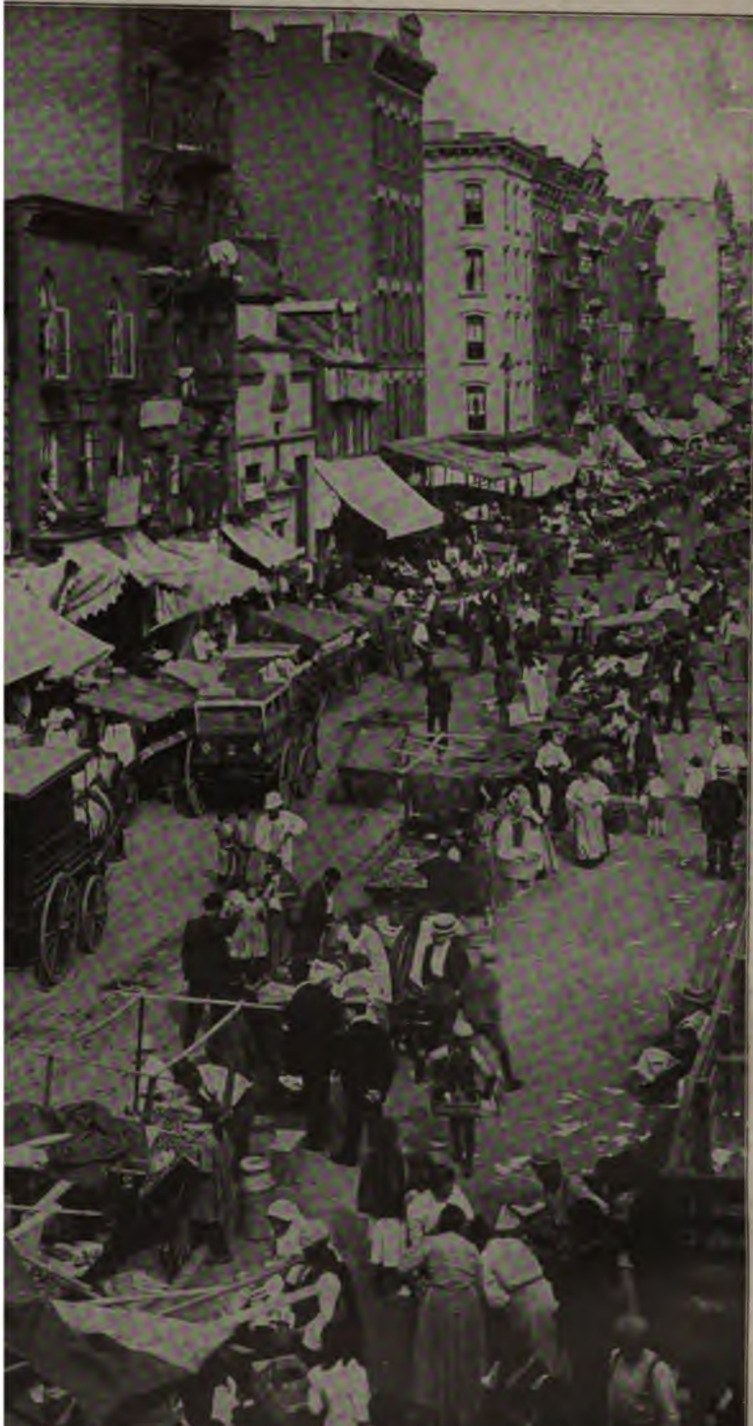
great international exposition, so carefully selected are the goods and from such widely diverse markets of the world do they come.

Once out of the business district of the city, and passing through the more crowded residence portions, another evidence of the multitudes who dwell in such a center of population may be seen. "Blue Monday" is just as regular in its arrival in the city of a million as it is in the small village, and the freshly washed garments of the household need sun and air for drying in like manner. Without beautiful lawns and ample grounds around them as have the more favored quarters in the less crowded communities, the people of the tenements must utilize what facilities they have. The essential and practical clothesline is made the subject of household ingenuity. The narrow back yards between the tenements are criss-crossed with an apparent tangle of lines, some high in the air and stretched to telegraph poles, or from house to house between fourth-story windows. The glimpse of such an area thus decorated, on a city washday when the sky is clear and the bright sun has encouraged the outdoor drying of the fresh linen, is peculiarly novel, and suggests forcibly the crowded fashion in which people in the city must live.

The immigrants who come to America generally choose to settle in communities in the cities, forming streets and even whole districts of their own nationalities. In New York and Chicago Russian, Jewish, Polish, Italian, Chinese and other special quarters have been established, where they preserve their European customs and afford interesting street sights for strangers.



phic Co.
EWISH QUARTER OF NEW YORK CITY ON A BUSY MARKET DAY.

ars, which would enough to reach from New York pens when filled 0,000 cattle, and e 13,000 of the 8,500 are roofed pens for hogs are ked."

afternoon there is another rush when the cars of the eastern lines are laden with the outbound shipments of dressed and canned meats for the eastern markets and for export. The Stock Yards Company owns the railroad tracks and charges toll for them. When a load of stock is placed on a side track, the cattle or hogs are driven into the pens assigned them, to await the

NG THE CATTLE PENS, CHICAGO STOCK YARDS.
ıg one of the great packing houses in the background.

ning hours, the a busy one. Bek, nearly 35,000 for their employer, the packing-industries. The me of unloading from the western l, and during the

call of the commission men to whom they are consigned. The sales go on all day long, and are marked by methods that have been gradually simplified to a most extraordinary degree. From the chutes the animals are driven to pens that custom has given to each particular firm. Here they are inspected and sold. Government inspectors throw out poor stock, while the

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developed as adjuncts to the Stock Yards of Chicago, that everything is saved of the slaughtered animals except the squeal of the pigs. So complete is the utilization of every shred of what in a less perfect organization might be called waste, that the ancient jest becomes almost literally true. It is to this fact that in large degree is attributed the rapid upbuilding of the immense establishments, and the steady growth of great fortunes for their owners. The value of the by-products saved from the refuse in a single large packing-house in the course of the year, itself measures almost a fortune, and establishes the difference between profit and loss.

Let us follow the processes of a typical

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a powder for commercial purposes; the bladders are dried and sold to druggists, tobacconists, and others; the fat goes into oleomargarine, and from the hoofs and feet and other parts come glue and oil and fertilizing ingredients.

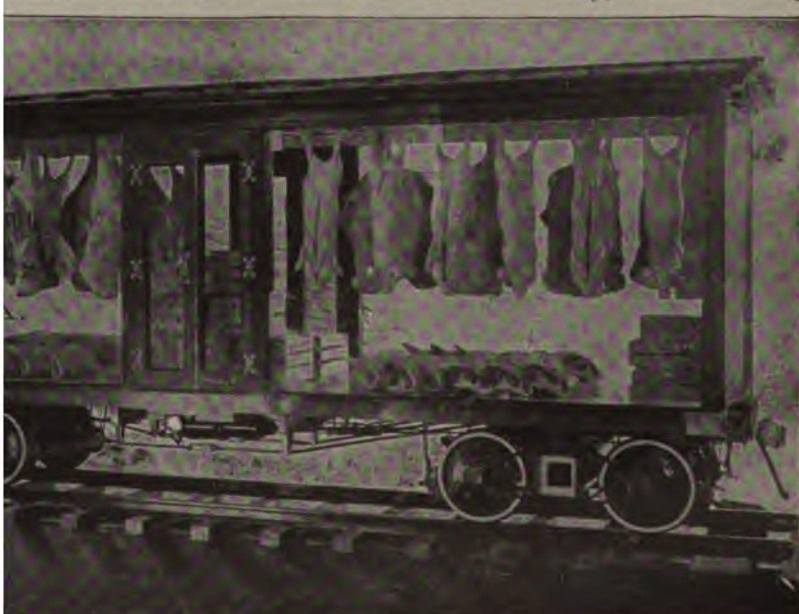
Over the slaughter house is a series of rooms heaped full of bones and horns. The bones are boiled to get the fat of the marrow as well as to clean them. Then they are dried and shaken about until they are as smooth and clean as cotton-spools. The knuckle-joints are cut off them, and one room is filled with the ground-up flour of those parts. The white and pretty bones that remain are shipped to Connecticut, England, and Germany, to be worked into knife-handles, fan-handles, tooth-brush handles, backs for nail brushes, sides for pen-knives, and into button-hook handles,

KING THE MEAT FOR CANNING PURPOSES.

MAKING BUTTERINE.

t, and death is prac- The dead body sened over a vat of which it is plunged. e, and the water is . Suddenly a great and it falls upon a that is hooked to its nose pulls it through a steam-scraper. The knives of this machine are set at every angle, and miss no part of the hide on the body.

Once out of the reach of the scraper a number of men pass the body along, and remove every bristle and speck that was missed. Then the body, still traveling



EFRIGERATOR CAR AS PREPARED FOR SHIPMENT.

glass wall of this car constructed for exhibit the exact arrangement of the meats may be seen.

of men in wait- in the process stick the knives ite of twenty a ontinue to pass ecialists at that

verily astonishing. One company in a single year has purchased live-stock to the total of 1,437,844 cattle, 2,658,951 sheep and 3,928,659 hogs. Sales the same year amounted to $150,000,000 and the shipments required 107,684 railway cars. From

RESSING MUTTON IN A PACKING HOUSE.

cass appears at ead apart with r the refrigerat-

ar's business of king-houses are

this number of live-stock, the packing-house produced in addition to the meat, 196,244,588 pounds of lard; 6,472,857 pounds of wool; 3,888,983 pounds of neatsfoot oil; 5,487,540 pounds of glue; 8,116,338 pounds of butterine; 26,009,453 pounds of

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h a great city is their details, but in their entirety. etables, the manu- oultry and dairy the other articles bill of fare of the thered together in for neighborhood

supply, a very large part of the industrial activity of the world has to be levied upon to assist. The meats have come from the cattle ranges of the southwestern and northwestern states of our own country. According to season, fruits and vegetables may have come from Southern California, the Gulf of Mexico, the West Indies or our own immediate neighborhood. Whole train loads of milk come into the cities every morning from the dairy regions round about. Imported food supplies, such as spices, tea, coffee, chocolate and the multitude of other delicacies, are brought from all over the world. Fishermen are dropping their nets in the Mediterranean, or off the Grand Banks of Newfoundland, or in Lake Superior, or in the North Pacific to supply us with sardines or mackerel or

MAKING SAUSAGES.

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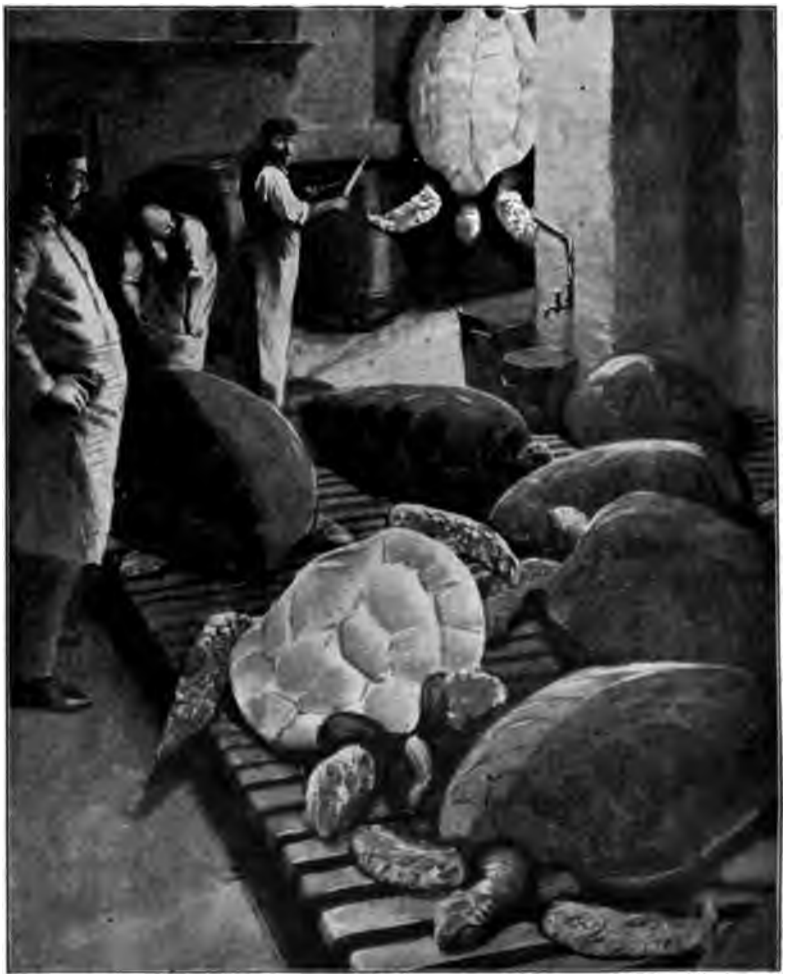
Here are dealers who purchase vegetable and fruit crops from all over the United States. Some of them have scores of buyers, who visit farmers throughout the coun-



PREPARING TURTLES FOR SOUP.

try, contracting for their fruit and vegetables. Other dealers specialize upon tropical products, and the banana trade, which is largely in the hands of Italians, has risen to enormous portions. Saturday is the busiest of all times on "the street."

THE SMITHFIELD MEAT MARKET, LONDON. THREE-AND-A-HALF ACRES UNDER ONE ROOF.

ING IN AMERICAN FORESTS

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used by the United States for the lumber and paper trade. This is equivalent to the product of about 4,000,000 acres of good virgin forest, an area equal to Rhode Island and Connecticut combined. This does not include the wood used for fuel, which is about four and a half times more. Four million feet is used for matches, the product of 400 acres of good virgin forest. About 620,000,000 cross ties are now laid on American railroads, and 90,000,000 new ties are required annually for renewals. There are now standing nearly 7,500,000 telegraph poles and 750,000 new poles are required each year for renewals. These figures do not include telephone poles and the poles required on new railway lines. The timber used for ties and poles each year is equivalent to the product of 100,000 acres of good virgin forest. The amount

LOGGING CAMP IN MICHIGAN.

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ELEPHANT PILING TEAK LOGS, BURMAH.

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Under the forests' shade, snow drifts, however, melt gradually throughout summer, thus supplying never-failing streams for the watering of the thirsty crops in the valleys below.

Recognizing these facts, Americans with foresight and prudence have induced the government to establish forest reserves in the United States, where no timber may be cut except under the most rigid and exacting restrictions. There are forty-one of these forest reserves in the United States, created by presidential proclamations according to an act of Congress, and embracing a total estimated area of 46,410,209 acres. The greatest of these is in Oregon, in which state a single reserve includes 4,588,800 acres. California, Washington, Colorado, Idaho, Montana, Wyoming, Utah, South Dakota, New Mexico, Oklahoma, Arizona and Alaska are the other states and territories in which forest re-

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The work of the lumbermen in the northern forests begins in the winter, when hauling on great sleds becomes the easiest way to bring the logs out of the forest. The life in the logging camps of Michigan at this season is one of hard work and little idle-

ING A BIG LOG IN AN OREGON MILL.

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ness, but the men become strong in it, and return to the same employment year after year. The logs are hauled over the snow to the banks of the rivers, to await the thaw in the spring. When the ice breaks and the melting snows cause the streams to rise, the logs are picked up by the current and carried down stream rapidly toward their destination. This is usually a milling town at the mouth of the stream, where the logs

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must be the finest furs of the rarest northern animals, cut according to the fashion of the current season and finished with skill and beauty. Wool from the sheep, the camel and the alpaca is sheared, woven and marketed all over the world. Fiber plants are cultivated and utilized most deftly for the making of such fabrics as appeal to the

IN A COTTON MILL—TEARING RAW COTTON FROM THE BALE.

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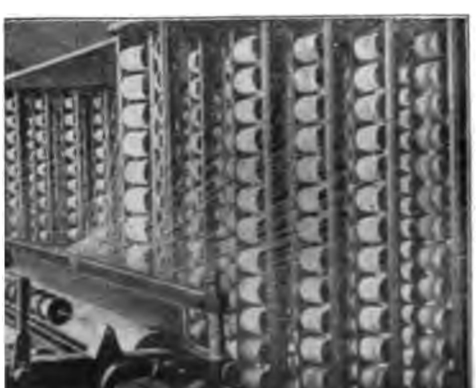
taste. Cotton is not the only vegetable fiber in use for thread, cloth and garments. In different countries, hemp, flax, jute, ramie, cocoanut-bark, pineapple fiber and other products are used locally for the production of cloth. The world over, however, cotton, wool and silk are the materials from which the garments of mankind are made. Linen is much reduced in favor, of late years, as cotton has multiplied. Silk, indeed, is the only fabric materially gaining on cotton and wool, and its advance is a natural one, justified by its beauty and explained by the increase of large trade with Japan, China and India, whence so much of the silk comes.



FROM THE SPOOL TO THE CLOTH.

The United States is the leader in the world's cotton trade. This valuable product was first raised in the United States in Virginia in 1621, and was first ex-

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SILK WINDERS AT WORK.

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shipping ports and markets are Galveston, New Orleans, Mobile, Savannah, Charleston and Richmond.

The manufacture of cotton in the United States has been growing rapidly in recent years. In 1890 the number of establishments for the preparation and manufacture of cotton and cotton goods was 2,641, and the capital employed was $366,000,000. For the manufacture of cotton goods alone, apart from mixed goods, there were 905 mills, with an aggregate capital of $355,000,000, employing 222,000 hands. The annual cost of material used was $155,000,000, and the value of the products $268,000,000. Ten years later the showing was greatly increased, chiefly by the establishment of numerous important mills in the southern states themselves. The tendency indicates that the time has come to take advantage of the cheap labor of the south, and the proximity of the cotton fields, to operate more economically and evade surplus freight on raw material.

WEAVING VELVET IN A SILK MILL.

HISTORY AND HOW IT IS MADE

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time passed other materials were introduced, plates of metal, skins and bones of animals, ivory, wood and wax being used.

It was Egypt that gave us the real forerunner of paper, and, indeed, the name itself, by a material made from the graceful water plant of the Nile, the familiar Egyptian bulrush or papyrus. Out of the pith of its stems were made sheets of a material not much indeed like the paper of to-day, but the pioneer of paper manufacture. Rolls of this material were made into books, and a large amount of the history and literature of the time was thus preserved for the use of students of to-day. The Chinese, about the same time, were independently learning to make paper from rice and silk. The first rival of papyrus was parchment prepared from the skins of sheep and goats.

NG RAGS FOR FINE BOOK PAPER IN A PAPER MILL.

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s one of the most important of the rag markets. They come to the factories in all conditions of filth, and the processes of sorting and cleaning are of the utmost importance to the perfection of the product. The mills making the highest grade bond paper, and that used for our paper money, use nothing, however, except new rags fresh from the mills or from garment factories where the trimmings are saved for the purpose.

When sorting and cleaning are done, the rags are chopped into small pieces, boiled for a day under steam pressure, and finally treated with chemicals for an additional cleaning and bleaching of the resulting pulp. By this succession of processes the

INTERIOR VIEW OF A GREAT PAPER MILL.

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clean linen rags, and there is a special attachment on the machine by which the silk threads always seen in our paper money are introduced. It is forbidden to make such paper for private use, under the same penalties that apply to counterfeiting.

Paper fills an important place in many mechanical arts, and there are various novelty papers made which have important uses. Paper made with a quantity of asbestos fiber is used for fire-proofing purposes; tar paper is used for covering roofs and lining walls; photographs are made up-

IING AND MAILING MAGAZINES IN A BINDERY.

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partment or another to produce and circulate the printed pages. In fact, the work of producing the paper begins long before the time of its publication, and enlists the energy of men who may be far away. The material equipment of presses, machinery and type comes from great factories where the highest mechanical ingenuity is employed to perfect the processes. The paper mills must turn out miles of broad, white ribbon, which, when printed and folded, becomes the morning paper. Back of the manufacturers and the paper mills come the miners, who toil deep in the earth to produce the metals, and the lumbermen of our northern forests, who cut and raft the logs from which the paper is made. Correspondents the world over keep a multitude of telegraph operators busy, transmitting the important facts of the day to the office from which the paper is to issue. Railways run special trains to insure prompt distribution of the finished journal, and by the time the newsboys, the clerks in the business office, and the editorial staff itself are added to the list of participants, the number who from the beginning to the end have shared in making the paper, which the reader buys for a cent, is an astonishing one.

In order to carry on all these manifold operations harmoniously, and without delay at a critical time, a great newspaper must be organized with the utmost care. The business, the mechanical and the editorial departments have their distinct functions, all of prime importance. It is the business department that does the work of securing subscriptions and advertisements, circulating the paper to subscribers, collecting bills and paying expenses. It is a self-evident fact that a carelessly managed business de-

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old method of setting type by hand has been done away with, by the invention of a mechanical device called the Linotype machine. By this machine one type-setter can accomplish as much as five or six hand compositors, with a higher average of accuracy. The Linotype, invented and perfected by Ottomar Mergenthaler, is a cumbersome and complicated apparatus, but it achieves its purpose with what seems almost human deftness and skill. The operator sits before the keyboard, not unlike that of a typewriter. The upper part of the machine is a magazine of molds or matrices, each in its own box, and carrying at one end the form of a printed letter. In another place there is a quantity of molten typemetal, kept heated by a gas flame. As the operator taps the keys indicating the letters he desires to use, each matrix slips from its box in proper order and falls into place in a little tray made for the purpose. When these have assembled, to the length of a full line of type, an arm controlled by a lever lifts them to a set of clamps, where an impression is taken from them in the proper quantity of the hot metal. This is the line-of-type, cast in one piece, which gives the machine its name. The matrices are carried up to the magazine again by another arm, and by an ingenious device each is distributed to its proper place once more.

When the article has been put in type in this fashion from the manuscript, an impression is made from the type, called a proof, and this is sent to proof-readers, who examine it for errors which must be corrected. When the type has accumulated sufficiently to be classified, or made up into the page of the paper, this is done, and the entire page sent to the stereotyping room. The printing of great papers is not done di-

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is finished, it may be placed in the page of type and stereotyped like the type itself.

The perfecting printing press of the newest design and largest size is one of the most interesting pieces of mechanism to be found anywhere. The curved metal plates, or "turtles," from which the printing is done, are locked in place; the rolls of paper like great bolts of ribbon, perhaps six feet wide and five miles long, are hung in place on the press; the ends of the strips of paper are woven through the labyrinths of rollers, cylinders and wheels of the machine, an electric button signals the starting, and the clamor begins. Then from the further end of the press begin to fall the folded newspa-

FOR MAKING WHITE PAPER FOR NEWSPAPERS.

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portions, by printing one on top of another, will give any shade or color desired. One plate is arranged for printing the blue, another for the red and another for the yellow. Each picture must go through the press three times for these colors to be put on, one at a time, and of course the work must be very accurate so that the successive impressions will be in the right place. When the work is finished, however, if this is done properly, there is a remarkable colored picture produced, with artistic effects, and yet at great speed and moderate expense.

Not merely mechanical processes, but genuine artistic ability as well, must be employed to obtain such results. The one to whom this work is given, carefully studies the subject to be printed, as to its color, and the proper combination of inks to produce the desired colors is decided. The first plate of the three is then arranged for printing in blue. All that portion which is to appear in heavy blue has a heavy surface left on the engraving; the lighter shades are stippled more, eaten out by the acid or carved out by hand, according to the degree of intensity needed. That portion which needs blue in combination with one or both of the other colors is shaded in proportion. This plate, after being thus made ready, is marked near the edges with lines which aid in printing the next color, exactly on top of the first at the proper place.

Next the plate from which the yellow is to be printed is prepared in the same way, and the red plate completes these preliminaries. Proofs of each plate are taken separately and together to see if the right color scale has been worked out. If the final proof is correct, the register marks should exactly coincide, and the colors

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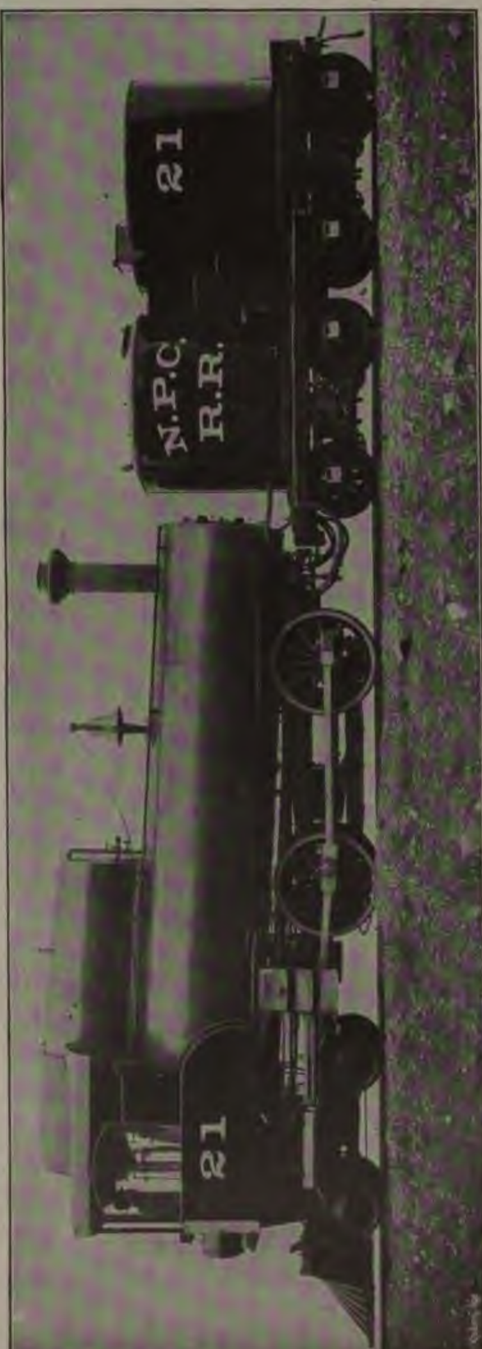
Russia and Siberia, the American traveler finds himself drawn over the rails by an American engine. The American factories,



AN OIL-BURNING LOCOMOTIVE.

BLACKSMITH SHOP IN BALDWIN'S LOCOMOTIVE FACTORY.

EVELOPMENT AND TRANSMISSION

natural philos- give off more hat something nothing. Log- ago given up r invent some on. Instead, voted its in- ements in the he mechanism gine that can of the power

naturally developed, by the loss in friction. The ideal toward which inventors strive is the reduction of friction, so that as much as possible of the power actually produced shall be used for the purpose intended, with as little waste as possible in the mechanism of the engine itself.

It is the enormous waste of power in transmission that is rapidly causing the cable-railways of city streets to be super-seded by electric car lines. Electricity is one of the most economical of all powers to

R OF A CABLE-RAILWAY POWER-HOUSE.
passing over the wheels which move and stretch them.

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D—FURNACE ROOM OF THE CHICAGO PUBLIC LIBRARY.

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possible. This cable extends in a great circuit from the power-house, throughout the length of the line, over a large pulley, and back by another parallel track of the line, to the power-house again, where it passes over the great wheels connected with the engines which give it its forward motion. In order to cause the cable to move onward continuously at a regular rate of speed, an intricate device for keeping it stretched must be used, which increases the friction. It is evident that the weight of such a cable several miles long, and the friction which it generates in passing over the succession of wheels and pulleys, must

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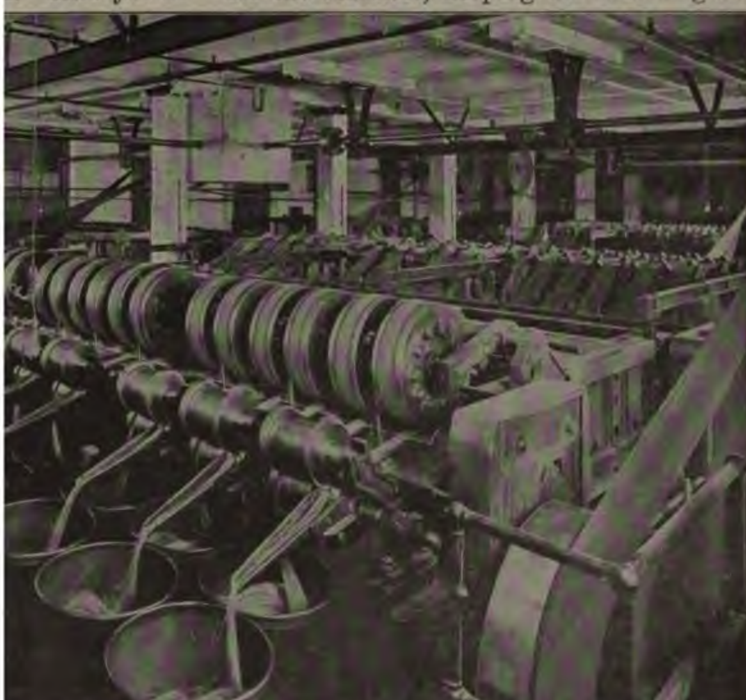
e. And yet in many cities cable railways have proven of great value for years prior to the introduction of electric lines.

The immense power required for large manufacturing plants can hardly be realized by those who have not come in contact with such conditions. Great battleships and passenger liners in some instances have boilers and engines sufficient to develop 30,000 or 35,000 horse-power, or as much as the entire power required for all the machinery at the Chicago World's Fair of 1893. Great factories in some instances, too, require plants of almost as much magnitude. The battery of boilers such as one may see in a modern manufactory on a large scale is an impressive sight.

To some extent firemen have been eliminated in such institutions, by the invention of automatic appliances for supplying coal for the furnaces, keeping the fires in good



NG BINDER TWINE FROM MANILA HEMP.

THRESHING MACHINES IN THE FIELD.

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farms have grown in the possession of capitalists, who conduct them as methodically as they would any other productive industry. In North Dakota, for instance, wheat farms of 20,000 acres are not uncommon. A farm of this size requires executive ability, economy of administration and attention to details in order to assure profit, just as truly as would a cotton mill or a coal mine. Batteries of reapers sweep across the wheat fields at harvest time. Platoons of harvest hands work in the fields. And yet even such an enterprise demands skill and intelligence and attention no more truly than does any one of our fertile farms, if the highest results are to be obtained from it for the owner.

LTRY PLANT IN THE WORLD, IN THE STATE OF OHIO.
production 100,000 chickens, 73,000 dozen eggs.

WINDOW GLASS MAKERS AT THE MELTING FURNACE

GLASS AND ITS USES

Without glass in its various forms, the modern household would be quite at a loss. Glass enters into so many of the essential conveniences of life, of the commonest sort, that we no longer think of it as a luxury, but as a prime necessity. Windows, dishes, bottles, lamp chimneys, mirrors and ornaments are among the first uses that come to mind, all entirely ordinary to us. And yet there are lands and tribes where glass is unknown, except as it is brought to them by traders from the outer world. The wild races of the Pacific Islands and Central Africa, like the Eskimos of the far north and the American Indians, knew nothing of glass until the white men taught them its uses. They were not slow, however, to see the value of such material, and trinkets of glass or small mirrors have been among the most effective articles of trade in the dealing of explorers with these people.

Glass was first made in England by Benedict, a monk, in 674, but at that time it was recognized only as a novelty, and not of any special value. The first use of it in England' for bottles was in 1557, and in the same year the first window glass was made there. More than one hundred years later, in 1673, the first plate glass was made in Lambeth, England.

Now there is no house so mean that it does not have glass in use in many forms. The decorative value of the material is great, and there is no more interesting display of the finer fabrics of the world than can be seen in the illuminated windows of a great city shopping street, extending for miles, and forming a crystal wall behind which the choicest fabrics are displayed. The incandescent electric light, too, requires the transparent bulb of glass to enclose it, so that we owe our brilliant light to the same common substance.

Glass factories have grown to immense proportions, particularly in the eastern states, where coal and natural gas are readily at hand tor the immense quantity of fuel and the necessary mineral substances required in the manufacture. Pennsylvania and Indiana are among the states which lead in glass production. In the former state there are thirty glass factories, with an invested capital of more than $15,000,000 and an annual value of products of more than $9,000,000. Indiana has about twice as many factories, with a corresponding output. The employees in the glass factories of this state number 10,000 and their annual wages amount to nearly $5,000,000.

In the countries where glass is not known, the same substitutes are still used that were employed hundreds of years ago. Sheets of mica, bits of skins and other such makeshifts are made to answer the purpose, or else the windows are left wide open. In the Arctic regions, indeed, thin sheets of ice are fitted into the walls of the snow houses, and the light penetrates through them. For bottles, wooden or earthen vessels are used. But in the civilized countries to-day, glass is so cheap and so common, thanks to the improved methods applied to its manufacture, that no one is denied its use. It is in this cheapening of the necessities that are of universal use that modern industry makes one of its most conspicuous successes.

GLASS-BOTTLE BLOWERS AT WORK.

ARTIST DECORATING POTTERY.

decorated and glazed, after which in great ovens or kilns it is subjected to a high degree of heat, and this burning hardens the clay and makes permanent the decorations and the glaze. It is the variety of clay, the artistic ability devoted to the forming and decorating of the object, and the quality of the glaze or final finish, which regulate the beauty and the value of the product. As interest in household art has increased within the last decade, there has been a marked increase in the public appreciation of choice plastic wares, and this is resulting in a gradual improvement in what are now offered for use in the household, for decorative or practical use.

HOW PIANOS HAVE MULTIPLIED

There is no more conspicuous evidence of the manner in which all people profit by improved industrial and commercial methods, than is shown in the business of piano manufacturing. It is but a few years since a piano was a genuine luxury, to be found in the households of none but the rich, or those who made professional use of their musical talents. To pay $1,000 for a piano meant nothing exceptionally fine in the instrument under the old regime. The piano manufacturer might be himself musician, designer, workman, business manager and salesman of his factory.

To-day all this has changed. The im-instruments, was next in favor, and was the resource of those who could not find money or room for the larger instrument. As the square piano improved it became more popular, and until twenty years ago was one commonly seen in most households. To-day the square piano has almost vanished. The upright has taken its place as a better instrument, far more convenient in form, and economical of space in the room. The grand piano with its greater size, strength and volume of tone, must retain its place for professional use, but it is safe to say that 900 out of every 1,000 pianos made in the great factories of the United States, are of the form known as the upright.

American pianos, like other American products, are finding their way far afield. Those makes which are best known in this country as reliable and popular instruments, are recognized likewise in England and upon the continent of Europe. Some American manufacturers, indeed, in order to enter the European market to best advantage, have established selling agencies and even factories across the Atlantic, where their goods are produced and sold, to be another item in the American advance in the industrial and artistic world. Such enterprising manufacturers seek for the best materials and the best markets the world over. Good pianos must be constructed out of good materials. It is not merely the beautiful veneered and polished case, but the strength of the frame and volume of the tone, that tell the story, and in these details American piano manufacturers admit no superior.

FINISHING CASES OF UPRIGHT PIANOS.

THE WORLD'S BIG CANALS

For hundreds of years canals have been built to facilitate trade within the interior of countries, and to connect river systems. Some of these artificial waterways have been of great length and great commercial importance, although of late years, with the rapid development of railways, the construction of such canals has virtually ceased. The same spirit of energy, however, that once exerted itself in this manner, has now turned to greater works, and ship-canals, connecting the oceans of the world, have become the object of such efforts.

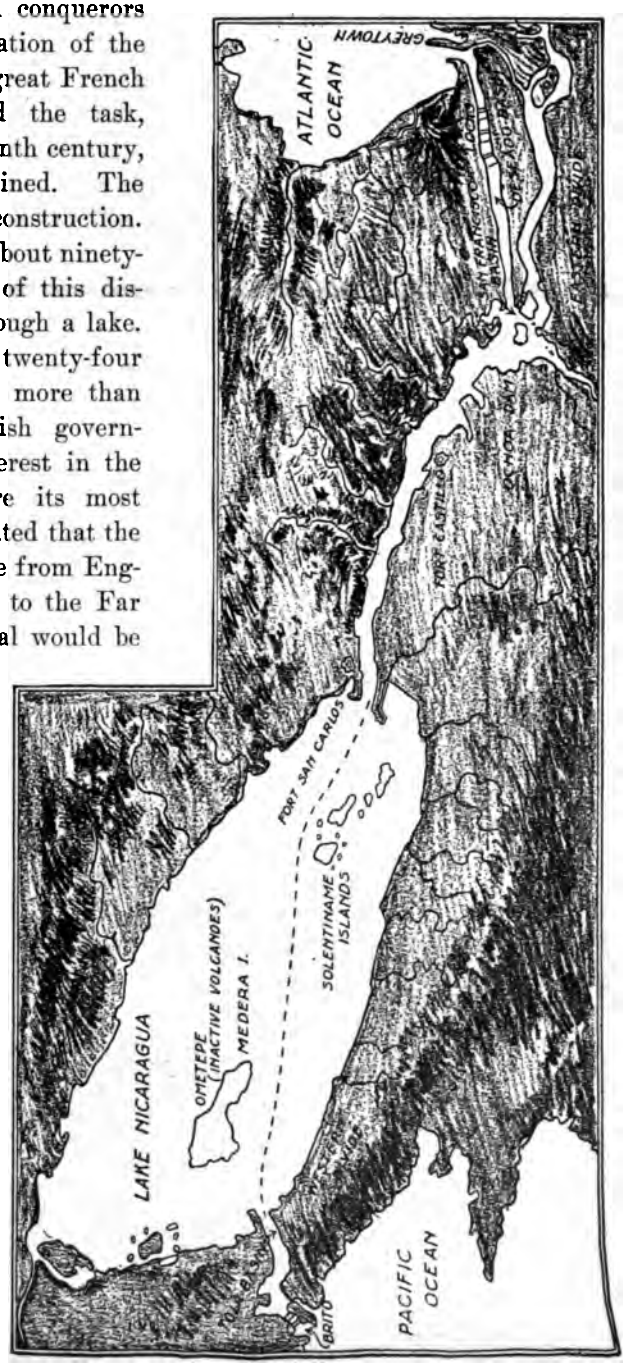
The Isthmus of Suez, connecting Africa with Asia, and separating the Red Sea from the Mediterranean, in the Eastern Hemisphere; and the Isthmus of Panama, connecting the two continents of America, and separating the Atlantic and the Pacific Oceans, in the Western Hemisphere, have long been contemplated by mariners and merchants as barriers that ought to be pierced for the sake of the world's commerce. This object at last was accomplished some thirty years ago, as far as Suez was concerned, and our own American transisthmian canal, by some

DAM AT LOCKPORT, ON THE CHICAGO DRAINAGE CANAL.

one of the rival routes, is certain to be cut and completed for traffic before many years have passed.

Egyptian kings and Roman conquerors in turn attempted the excavation of the Suez Canal, but not until the great French engineer De Lesseps assumed the task, about the middle of the nineteenth century, was any effective result attained. The canal was thirteen years in construction. It is twenty-six feet deep and about ninety-six miles long, although part of this distance was mere excavation through a lake. Steamers pass through in twenty-four hours, and the tolls average more than $4,000 per vessel. The British government owns the controlling interest in the canal, and British ships are its most numerous patrons. It is estimated that the saving of distance in the voyage from England to India is one-half, and to the Far East one-third of what the total would be if it were still necessary to go around Africa. The saving to commerce is many millions of dollars a year.

The American canal, connecting the Caribbean Sea and the Pacific Ocean, will be hardly second in importance to the Suez Canal. The total length from sea to sea by the Nicaragua route is 183.66 miles. By this route the natural waterways of the San Juan River and Lake Nicaragua would be utilized, and the length of the artificial channel would be but 26.7 miles. The Panama route is 49.09 miles long, and of this a great part was accomplished by the French Company organized for the purpose, which failed before completing the work.



ROUTE OF THE NICARAGUA CANAL FROM OCEAN TO OCEAN.

Total length, 183.66 miles; excavation required, 26.7 miles; highest elevation of canal above sea level, 110 feet; length of high level, 153.2 miles; number of locks, 6; locks 800 feet long, 100 feet wide; depth of canal, 30 feet; least width at bottom, 100 feet; estimated time from ocean to ocean, 44 hours; length of Lake Nicaragua, 110 miles.

Surveys for the canals have been exhaustive, and every detail necessary to guide the engineer in the construction is well known. The route of the Panama Canal extends from Colon on the Atlantic side, to Panama on the Pacific, passing over twenty-five miles of river, eight miles of mountains and the remaining distance of bottom land. The estimated cost of completing this canal is $145,000,000. This added to the $10,000,000 demanded by the French Company for the part of the work which they have completed makes a total cost by this route of $185,000,000, or about $5,000,000 less than by the Nicaragua route.

GREAT DAM ACROSS THE NILE—UPPER EGYPT.

These interoceanic canals are not the only ones of great importance. The Germans, for instance, constructed the Kiel Canal from the North Sea to the Baltic, by which vessels of the largest size pass directly back and forth without needing to make the great detour around the peninsula of Denmark. A similar result is obtained for ships in Lake Superior, in our own country, by a canal cutting through the great Keweenaw Point on the south shore, thus avoiding a long detour. Within the interior of many countries the canal systems play an important part in commerce. The Erie Canal, for instance, connecting Lake Erie with the Hudson River, is an important waterway across the state of New York. The Welland Canal, built by Canada between Lake Erie and Lake Ontario, enables vessels to pass around Niagara Falls and thence to the St. Lawrence River, where another succession of canal locks around the rapids of that river give access all the way to the Atlantic Ocean. The United States Government, with its greatest of all canal locks in the St. Mary's River connecting Lake Superior and Lake Huron, at Sault Ste. Marie, surmounts the difference in level between those lakes, and navigation is therefore virtually uninterrupted between Duluth or Chicago and our Atlantic ports.

Many of the European countries have carried canal building to important proportions. All of the larger river systems of Russia are connected, and the canals of Holland, Belgium and France are famous. The Russians have been active in

Asia, too, and by the river systems which they have connected with artificial waterways, it is possible to pass with boats all the way from the Ural Mountains to Lake Baikal in the heart of the continent.

Latest of all great canals is the one built by the city of Chicago, for drainage and sanitary purposes, connecting the head waters of the Chicago River with those of the Mississippi. The former stream has been a receptacle for sewage and a menace to the city's health, because of its contamination of the municipal water supply in Lake Michigan. The opening of the canal turned the flow of the river in the other direction, and Lake Michigan now has an outlet to the Gulf of Mexico, diluting and purifying what was once a noxious stream. This canal, some thirty miles long, required seven years for construction and cost about $35,000,000. It is deep enough for ocean vessels and some day it is believed will be a channel for a great traffic.

Long before white men came, the Chicago River was an important route for the wandering Indian tribes of Illinois. A very few miles and a very low ridge separated the headwaters of the south branch of that stream from the Desplaines River, which is a tributary of the Mississippi by way of the Illinois River, so they could drag their canoes over this short portage and continue their journey in either direction with the utmost ease. The first white explorers utilized the same route in passing between the basin of the Great Lakes and the Mississippi Valley. It is evident, therefore, that Chicago grew where it is, not by chance, but because of natural conditions which were potent in commerce and industry.

Many years ago a small canal was cut connecting these same waters, which had its considerable commercial importance for a time. Then as the city grew, it became necessary to make some provision for the wholesome water supply required, and for the disposition of the immense quantity of sewage turned into the river. It is doubtful if any municipality ever carried to successful completion a greater undertaking than this Chicago drainage canal, or one more important in its far-reaching effects

COMPRESSED-AIR DRILL, CHICAGO DRAINAGE CANAL.

on the city's health and commerce. The blue waters of Lake Michigan were left untainted by the impurities which had been poured into them, and an inexhaustible supply of this essential factor in the wholesome domestic life of a great metropolis was made uninterruptedly available.

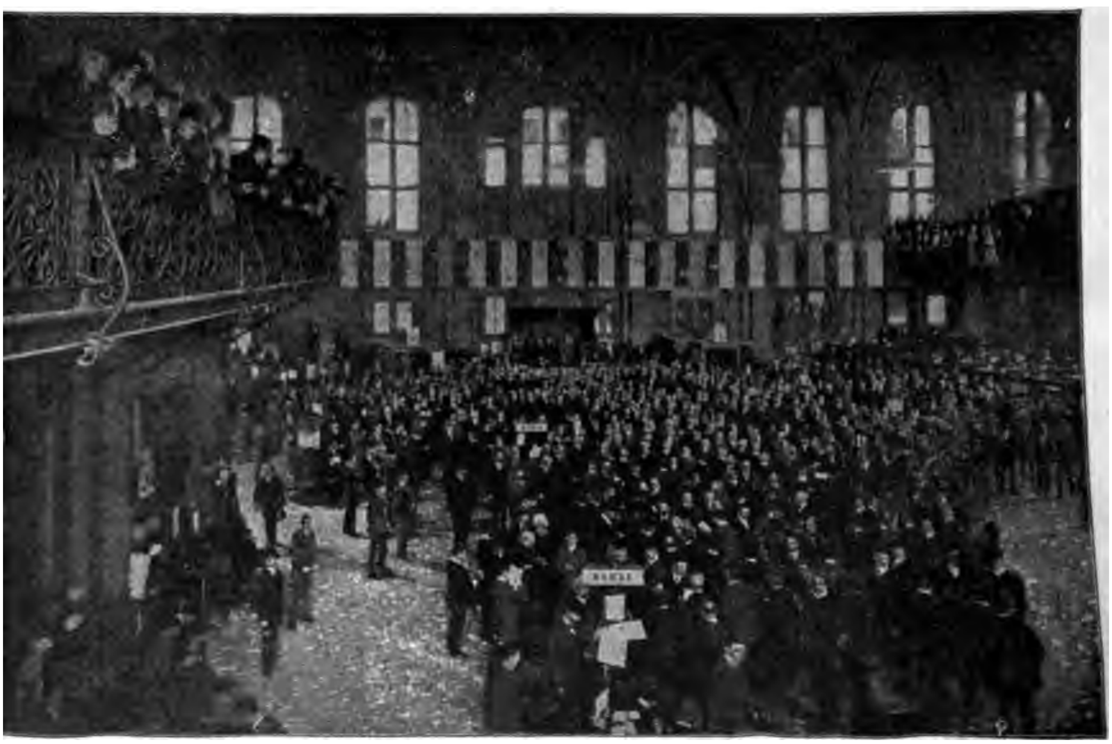
The increased reverse current of the river scoured the banks, purified the river itself, distance. It is not wise, therefore, to accept every speculative suggestion of a great engineering undertaking as actually on the road to being accomplished.

HALSTED STREET LIFT BRIDGE OVER THE CHICAGO RIVER.

The whole platform of the bridge roadway is lifted high in air like a great elevator when vessels are to pass. The bridge is operated by electricity.

companies and other corporations. Owing to the intimacy of trade and communication between the various markets of the world, the importance of these controlling organizations continually grows, and the condition of the market in any financial center responds rapidly to influence throughout the world.

banks are gaining in this country at a startling rate of speed. At least one bank in New York City has a capital of $25,000,000 and a surplus of $15,000,000, while two others in that city and one in Chicago exceed $15,000,000 in capital and surplus. With deposits in their vaults ranging from $50,000,000 to $125,000,000, and connec-



"WALL STREET," THE FAMOUS NEW YORK STOCK EXCHANGE.
This was the last photograph taken of the old Stock Exchange where so many financial "panics" have occurred, before it was torn down to make way for a splendid new building.

Banks are growing in size and influence with great rapidity, the tendency being toward the consolidation of such institutions in cities, with immense capital and far-reaching connections. The Bank of England, the Bank of France, the banking houses of the Rothschild family, and others in Europe, far surpass anything we have in America. Along with the growth of trusts industrial organizations, however,

tions with smaller city and country banks all over the United States, it is apparent that the financiers who control such great institutions exert wide influence upon the business affairs of the nation. The significant thing in this enormous capitalization of city banks, which was not even dreamed of five years ago, is that it is a reflection of the gigantic strides of America toward the commercial supremacy of the world.

New York looks forward to the proud eminence of being the financial center of the world. This greatest of American banks has been an important factor in many of the recent colossal combinations or "Morganizations," engineered by J. Pierpont Morgan and other financial giants.

The method of trading that has grown up in boards of trade and stock exchanges is full of technicalities that puzzle the visitor. In an excited state of the market, the confusion is bewildering. Traders are shouting their sales and purchases into each other's ears, or frantically waving their hands high in the air, with one or more fingers extended to signal what they mean, according to a code that is well understood. Of course the actual transfers of stocks or provisions are very great, and still this phase of the business is far exceeded by mythical dealings in "futures." When a sale is made for a future delivery at a given price, this does not at all imply necessarily that the goods are to be delivered. Instead, when that date comes around, if the actual market price of the commodity is higher than the contract price, the one who

BANK VAULT DOOR OPEN.

"THROGMORTON STREET," THE LONDON STOCK EXCHANGE.
This photograph was taken during the British war in South Africa, on a day of great public excitement.

THE CHICAGO BOARD OF TRADE.

The octagonal rostrums, with steps leading to them, have depressions in the center, at the floor level, and these are the "pits" which figure in all accounts of trading.

has sold simply pays to the buyer the difference between these two figures. If the contract price is lower than the current market price, the buyer pays the difference to the seller, and the deal is thus closed.

It is this condition that justifies the familiar charge that such deals are but bets as to what the price will be at a certain time in the future, the loser to pay his loss. "Puts" and "calls" are privileges to deliver or to claim a certain commodity at a certain price in the future. The one buying the privilege to deliver to another, or to demand from him under such circumstances, is in effect betting that the price will fluctuate in the interval in such a way as to give him a profit.

Traders are divided into two general groups known as "bulls" and "bears." Any man holding a commodity and wishing to sell it, or holding a future privilege to call for it at a fixed price, naturally desires to see the price of this commodity rise, and devotes his energy to hoisting the price in any way possible. He is therefore known as a bull. The bear, on the other hand, is the one who wishes to buy a commodity, or who has an outstanding contract to deliver at a fixed price at a future time, that which he has not now in hand, and his interest therefore is to depreciate the price. It is this condition that makes the eternal quarrel between the two elements on the market, although, of course, they are coninto more sightly form, although it is long before they take on the final polish.

For silver dollars, for instance, long strips of the metal are molded to the proper thickness and proper width. They are passed through a press which first stamps out discs of the metal of the proper size and shape for the finished dollar. These discs undergo a polishing process, and then great hoppers of them are placed over the coining machines, from which they trickle out a stream of shining dollars. A single motion of the machine turns out the coin from the discs. Two dies, one for each side of the coin, meet with irresistible force and stamp the designs upon the metal, while at the same time the milled edges are formed by the encircling pressure. The coins then are given their final polishing, after which ingenious automatic scales weigh them, separating the ones that are too heavy or too light from the perfect ones, to be returned to the melting pot for another coining process. But few people are so indifferent to the enticements of money that they fail to be impressed at the sight of gold or silver dollars, pouring in a continuous stream from the coining machines in the mint.

The old mint at Philadelphia, from which hundreds of millions of dollars of coin were turned out during the nineteenth century, has been supplanted by a splendid new building, equipped with the most modern machinery, and doubly effective for the convenience of its arrangements. There

THE NEW UNITED STATES MINT AT PHILADELPHIA.

are mints also at Denver, New Orleans, and San Francisco, and government assay offices at New York, St. Louis, Deadwood, Helena, Boise, Carson, Seattle and Charlotte, N. C.

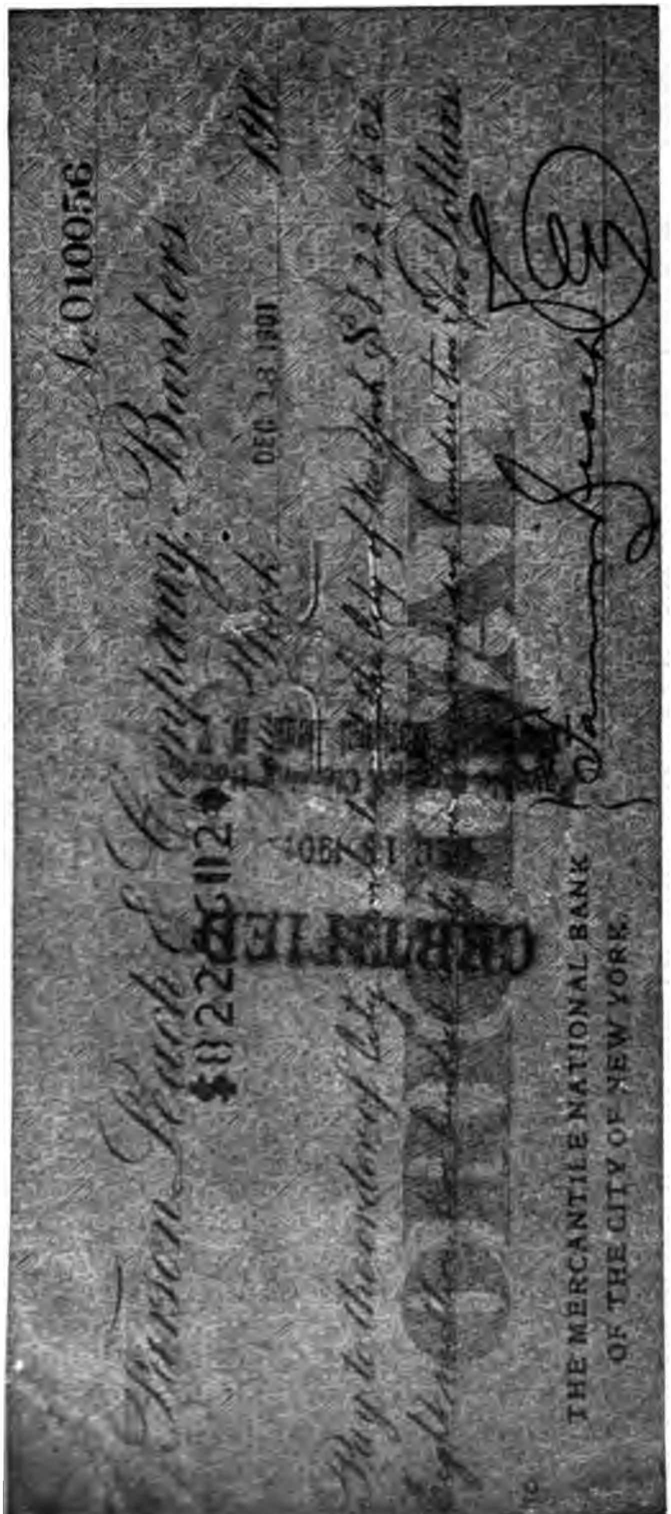
The assay office is practically an outside agency for a mint. It receives the bullion, ascertains and pays its coinage value less any bullion charges that may be made for the service, and ships it to one of the mints. The equipment and organization of a mint are expensive, and it is cheaper to concentrate coinage operations in a few institutions than to multiply mints. An assay office renders practically the same service to the mining industry that is rendered by the mint. The New York assay office receives the bullion upon precisely the same terms as a mint, but the others make a special charge of one-eighth of one per cent in addition to mint charges.

Gold bullion that is of standard fineness, and requires no treatment to fit it for coinage, is received and coined without charge. If it contains base or other metals which must be removed, a refinery charge is made, and if it is above the standard an alloy charge is made. The law provides that these charges shall equal, but not exceed, the cost of the service. The total number of pieces of coins struck by the mints of the United States in 1901 was approximately 185,000,000, and the value about $140,000,000. This exceeded any record before made by any government.

HAULING INGOTS OF SILVER BULLION IN THE PHILADELPHIA MINT.

EIGHT MILLION DOLLARS IN ONE CHECK

The largest financial transactions are not settled by a transfer of coin, or even paper money, from hand to hand. The very weight and bulk of the money required makes that impossible. Instead bank checks are used for settlement of great obligations,



Used by permission.

MADE FROM PHOTOGRAPH OF ORIGINAL CHECK FOR OVER EIGHT MILLION DOLLARS THAT WENT THROUGH BANK AND WAS PAID.

and the money called for can be transferred at will from bank to bank, according as the customer desires. The check reproduced herewith is believed to be the largest ever drawn in any American transaction, if not in the world. It calls for the sum of $8,229,602.51, and was made by the Chicago banking firm of Farson, Leach & Company, in their New York branch office, in settlement of a purchase of municipal bonds issued by New York City. The check was passed through the New York Clearing House, where the daily balances are adjusted between the banks, and it took the usual course of business papers.

If the amount of money represented by this check were paid in silver dollars, it would weigh about 300 tons, and would require a train of fifteen heavily loaded freight cars to carry it. In gold it would make eighteen tons, and one car would be sufficient. It is hard to conceive such a sum of money. Invested in ordinary dwellings, at an average cost of $2,000 each, this is enough money to build 4,100 houses, or as many as comprise the ordinary American city of 20,000 inhabitants.

ORANGE GROVES AND THEIR PRODUCTS

Thanks to the semi-tropical climate of our favored southern states, particularly Florida and Southern California, we are enabled to have a current supply of luscious fruits and vegetables of subtropical character which only a few years ago were considered as genuine delicacies of some rarity, instead of being commonly found in the markets as they are now. In addition to these newly developed regions of our own country, commercial enterprise of late years has placed Central America, Jamaica and certain others of our neighbors in the Caribbean Sea under tribute, for still further tropical delicacies, and now the volume of trade in such foods has become very great. Bananas, for instance, come to us in immense shipments, the year round, from Honduras by way of New Orleans, and from Jamaica by way of Philadelphia and Boston. Our pineapple supply is chiefly from the West India Islands, although Florida sends an increasing crop northward every year, and the Hawaiian Islands have begun to contribute their quota by way of the Pacific coast.

PICKING ORANGES IN A CALIFORNIA GROVE.

ALLIGATORS ON THE INDIAN RIVER, FLORIDA.

from them. Although no part of the United States is actually within the tropics, yet in Southern California and Florida the warm climate makes possible the cultivation of most of the more important tropical plants. So it is that by varied climate, elevation and conditions, we have been able to develop industries and productions out of the animal, mineral, and vegetable kingdoms, in peculiarly favorable proportion.

Southern California has been called by the eminent writer, Charles Dudley Warner, "our Italy," and in Southern California grow many of the products which are recognized as characteristically Italian. Strange as it may seem, the largest olive orchard in the world is located here. The olive groves of the Mediterranean are finding a rival in this favored land, and the industry is recognized in California as one of the most profitable of the undertakings now under way. Only in a limited area of Central and Southern California, New Mexico, and Arizona, can the olive be produced in this country. It is quite certain, therefore, that there will not be an overproduction.

It is a proverb in Italy, that he who has an olive orchard has a perpetual fountain of wealth. It is more than 100 years since the first of these orchards was planted by the Spanish mission fathers of California, who did so much to influence the early industries and life of that state when it was a part of Spanish Mexico. The success of their olive trees proved the adaptability of the climate, and ever since that time the industry has been steadily increasing. The olives grown in California produce from twenty four to thirty-one per cent of oil. They are richer and more palatable when pickled than are the imported green olives from Italy, and the demand for ripe olives is continually on the increase. The older the olive tree becomes, the more valuable it is to its owner, because of its prolific bearing. The wood of these trees is highly prized by cabinet makers for it is exceedingly hard and susceptible to high polish. It is greenish yellow in color, with black, cloudy spots and curving veins.

The great orchard in question is about twenty-five miles north of Los Angeles. There are 1,200 acres of olives in the orchard, 100 trees to the acre. About $225,000 has been expended in the improvements, and here in the grove is a factory with all the machinery necessary for marketing the whole of the product. They may be pickled and sold for table use, or the oil may be extracted. It is estimated that each acre of such an orchard will produce 2,000 gallons of olives this year. These will make 250 gallons of oil, which at $2 a gallon will bring the owner a revenue of $500 an acre. As the trees increase in age, this product is increased.

The average life of an olive tree is more than 250 years, but trees much older have been known to flourish and produce bountifully. Single trees in Sicily have been known to produce 240 gallons of oil a year, and to attain great size, the trunks measuring twenty-six feet in circumference and having an expanse at the top of fully 150 feet. Italy is the most important of the oil producing countries, yielding 70,000,000 gallons annually. Spain comes next with 23,000,000 gallons, and France follows with 9,000,000 gallons. The importation of bogus olive oil into the United States measures millions of gallons annually. Peanut oil, cotton seed oil, and other adulterations are imposed upon us.

COFFEE, TEA AND CHOCOLATE

The tropics and the orient have given to mankind three beverages now of world wide use. Coffee, tea and chocolate are known in every land, and varying in popularity each has its loyal adherents. Here in the United States coffee very much exceeds the others in popularity, with tea second and chocolate far in the rear. England is a nation of tea drinkers, with little favor given to coffee. In fact critics declare that it is hard to get a cup of good coffee in Great Britain. The English retort with, perhaps, equal truth, that it is difficult to obtain a cup of good tea in the United States. Holland is the country where the best chocolate is found, thanks to the Dutch colonies of the East Indies, where there is a large production of the bean from which it is prepared. France offers coffee as its favorite beverage, with chocolate and tea following in succession. It is in France that adulteration of coffee has been carried to the highest extent, and sometimes even in the best restaurants it is hard to trace the real coffee taste in the beverage offered. The Russians are the greatest of all tea drinkers, obtaining their supply chiefly by caravans into Siberia from the Chinese provinces where the best crop is produced. The Russian samovar or tea urn is perpetually alight in every household of the empire, and tea is served not only at every meal but to every caller between meals and at all sorts of surprising occasions. Even a business call at bank or office is almost certain to bring the offer of a glass of scalding tea, to be taken while the errand is explained.

The range of coffee culture extends over almost the whole of the tropical belt of the globe. The plant seems to bear greater climatic extremes than most members of the vegetable kingdom, and thrives in localities differing as much as thirty degrees in aver-

LARGEST COFFEE-ROASTING PLANT IN THE WORLD.

[illegible] temperature. It is interesting to note [illegible] many countries where the Coffea [illegible] the coffee of commerce, has been [illegible] indigenous varieties of the [illegible] plant have been discovered. In [illegible] for instance, at least sixteen species [illegible] growing in a wild state. The [illegible] average productiveness is about [illegible]. After that time the trees may [illegible] live and grow, but they yield [illegible] no fruit. In Java coffee trees planted nearly a hundred years ago are said to be in existence, being now some forty feet high with trunks a foot in diameter, but they grow entirely wild and produce no berries. On an average trees are replaced on the plantations every twenty years, and this process of replanting goes on constantly.

COFFEE YARD NEAR JALAPA, MEXICO.

Coffee grows best on the uplands, usually on mountain sides, at an elevation of from 1,500 to 4,500 feet above the level of the sea. The trees are raised from seeds in nurseries, and transferred to their final positions when about a year or eighteen months old. The plants are usually set at intervals of eight or ten feet. They begin to bear at the age of three or four years and at six years may be said to be in full bearing. Taking one year with another, a tree in full bearing produces from two to three pounds per annum. The average diameter of the trunk in full-bearing trees is about the size of a man's wrist. They bear a profusion of dark green glossy leaves, and the fruit or berry forms on the woody stems usually at the base of these leaves.

The berry, when ripe, is red in color, and much resembles a large cranberry or medium sized cherry The two beans lie within, face to face, and surrounding them are five successive layers of skin and pulp, covering and protecting the beans. Picking begins in Java in January and lasts for three or four months. The chief part of the Ceylon crop is gathered from April to July. A small crop, chiefly young coffee, is picked from September to December. In Brazil they commence gathering crops in April or May, and work continues until September. Women and children are largely employed in gathering the fruit, carrying it from the trees in baskets to the place where the preparation of the berry for market commences.

After the berries have been gathered, the first operation to which they are treated is called "pulping." This means to remove the outer covering of skin and pulp from the beans themselves. The berries may be treated while in the soft state, or they may be permitted to dry, after which the dried husk is removed by a machine. When this process is chosen, the berries are spread upon drying-grounds of stone, mortar or cement, where they stay until the heat of the sun prepares them for the machine. It is a similar machine, differing only in details, which is used when the berries are to be treated in the soft state. Successive cleansings, washings and dryings finally bring the coffee into a condition for shipment to the markets, thousands of miles from the plantations where it is raised.

Coffee as a commercial staple is naturally inseparable from coffee as a popular beverage. Amsterdam was for many years the center of the coffee trade, owing to the fact that nearly all the coffee of commerce came from the Dutch East Indies. With the rise of coffee cultivation in Brazil, the West Indies, Central America, Mexico, Ceylon, India and Liberia, the Dutch lost their control of the trade, and New York became one of the most important coffee ports. The United States consumes more than one-third of all the coffee exported from the producing countries. Out of a total annual world production of 750,000 tons, the United States takes about 280,000 tons annually, of which nearly three-fourths is the product of Brazil.

DRYING TEA IN CEYLON.

In Abyssinia and Ethiopia, where the coffee plant is found both wild and in a cultivated state, coffee seems to have been used as a beverage from time immemorial. In those remote regions the Arabs are said to have first tasted the fragrant draught, and to have brought some of the precious beans into their own country toward the beginning of the fifteenth century. The Mohammedan pilgrims who flocked annually to Mecca tasted the delicious beverage, and carried back coffee beans in their saddle-bags to all parts of the globe professing the faith of Islam. Coffee overran Egypt and reached Constantinople, where in 1554 the first coffee house in Europe was established. Nearly one hundred years later the first coffee house in London was established, in 1652, by the Greek servant of an English merchant who had brought some coffee with him from Smyrna. Within a few years Marseilles, Paris and London had numerous cafés, and coffee drinking was becoming common in England and France. During the eighteenth century it spread all over Europe, although the enormous prices of the berry restricted the practice to the wealthier classes.

For more than fifty years after the introduction of the beverage into Europe, Arabia still furnished the entire coffee supply of the world, a necessarily very limited quantity. Then the Dutch, early in the eighteenth century, appeared in the market with the product of Java, and a few years later the culture extended to the West Indies and spread with wonderful rapidity. Next Brazil entered the field, overtaking all rivals, until now more than one-half of the coffee consumed in the world issues from her fields. Java holds second rank in the list of coffee producers, Ceylon follows third, and southern India, Central America, Sumatra, Porto Rico, Mexico, Liberia and Arabia contribute to the world's supply.

The western hemisphere does not contribute commercially to the tea product of the world, although in our own southern states certain experiments have been made which suggest that good tea could be cultivated, even though it might not be highly profitable. Japan, China, the island of Formosa, India, and Ceylon are the principal tea producing countries. The tea plant is a species of camellia, bearing a thick and glossy leaf which when green has no tea flavor, or rather has a flavor very unlike the cured leaf known to us as tea. There is considerable variety in the mode of cultivating, but the prevailing system is to plant in rows about six feet apart. Three or four plants are planted together in hills which are about three feet apart, and usually as they grow larger they fill nearly the whole original space left between the hills, thus making an almost continuous row. The plants are raised from the seed, and take from three to four years to mature sufficiently to yield the first crop. After that they are picked continuously for many years.

GATHERING TEA IN CEYLON.

During the winter and early spring, in the districts yielding the best variety of tea, the plants are covered with mats which serve the double purpose of protecting them first from cold which might injure the plants, and later from the sun which tends to make the leaf tough and injures the delicacy of the flavor. The first picking, which is considered the best, takes place in Japan the last of April or the beginning of May, the second about a month later, while the third, which is often omitted, particularly when prices are low, takes place usually during the month of July. Left to themselves the plants would probably grow to a considerable height, but they are pruned and trimmed down so that they are seldom more than three or four feet high. This results in a large number of small branches, producing small and tender leaves, which are the only ones sought for, although in rapid picking different sized leaves would naturally be taken, together with a considerable quantity of stems and other trash. Immediately upon being picked, the leaves are taken to the buildings for the curing processes. The flat baskets in which the tea is brought from the fields are placed over the steaming apparatus for a few seconds, the steam permeating the mass and wilting the leaves. This gives them the dark green color, and enables the leaf to be rolled and doubled up, so that there is less liability to crumble when fired. They are then thrown upon large paper pans beneath which a gentle coal fire is maintained. They are toasted here for several hours, during which they are constantly rolled and stirred with the hands, so as to make the leaf as compact as possible. The tea is then placed in large baskets to await the sorting process.

The dried leaves are spread on a smooth tray before the sorters, who with a pair of chop-sticks dexterously pick out the stems and coarse leaves which are thrown aside as refuse. In the finer qualities they also separate the large from the small leaves, the latter being most highly valued. After the

DRYING TEA BY A HOT BLAST.

DELIVERING SUGAR BEETS AT THE FACTORY.

tea is thus sorted it is sifted to extract the dust and broken leaves, and packed to be sent to the market.

At the shipping ports, where tea is prepared for export, there is a second process of toasting or refiring the tea, and an additional cleansing, after which it is packed in chests lined with lead which is soldered and closed so as to be air tight. Then after nailing the boxes, covering them with matting or rattan, and labeling them, the tea is ready for the ships which carry it to the American or European markets.

The methods followed in China are almost the same as those of Japan. In some sections artificially flavored teas are produced. Flowers are gathered from the jasmine, and scattered over the tea, which absorbs much of the fragrance and is highly favored by epicures. The brick tea, which goes overland to Russia by camel trains, is an inferior quality, composed of the dust and siftings, mixed with other tea of ordinary variety. This is consumed by the Russian peasants. An enormous quantity of the finest grade of tea is taken by the connoisseurs of the same country, who are considered to be the most exacting of all the world in their choice of tea. Chocolate is produced in several of the West India islands, in Peru, Bolivia and Ecuador, and the Dutch East Indies. It is a product of the cacao tree, which bears a large pod in which the coarse beans are formed out of which chocolate is made. These beans are dried, roasted and ground. Cocoa is a modified preparation from the same substance. Porto Rico is the chief island of the Caribbean where chocolate is produced, and here is the principal source of the American supply. Students of health and diet of late years have recognized that chocolate is one of the most valuable food products, and not merely a stimulating beverage of doubtful value to the health like tea and coffee. Explorers and travelers now carry chocolate in condensed form as a valuable part of their commissaries. Soldiers find it in their rations, and invalids prize it as a food.

BEET SUGAR AND CANE SUGAR

When the Nebraska farmer drives into the factory yard with his ton of beets, he brings with him about 280 pounds of pure sugar secreted in the roots. Nature has been busy all summer with her apparatus of sunshine and rain, taking the elements of carbon, hydrogen and oxygen from the earth, air and dew, putting them together, and storing up the sweetness in the little sacs she has made for the purpose in the beet-root; and the great piles of brick and mortar, the groaning engines and the roaring furnaces, the pumps and pans of the sugar mill have been devised to extract sugar from the root.

The older method was to grate the sugar beet to a pulp, press out the juice containing the sugar, clarify it a little, and boil away the water, leaving the crystals behind. But in this way from forty to eighty pounds of all the sugar in the ton of beets went to waste, for no press, however strong, could squeeze out all the juice, and the sugar would lie hidden away in the little particles of pulp. So the crude method has been superseded by a more perfect one, with the result that greater factories have grown, farmers have planted larger fields of sugar beets, and the industry has become a factor of importance in national politics.

When the beets are brought in by the farmers, they are dumped into long trenches, V-shaped at the bottom, from ten to twenty feet wide and from six to ten feet deep, either covered with sheds or simply open ditches. At the bottom of each of these is another ditch, reaching downward, with perpendicular sides twenty to thirty inches deep, and having a curved bottom eighteen inches wide. This is a sort of flume, through which water will flow. All the ditches slope toward the factory, and meet in one larger ditch near it. Before the beets are thrown into the larger and upper trench, the smaller one is covered with short boards, laid across to prevent the beets falling into it. In these trenches or "silos" the beets are kept until needed. In warm weather they are covered with canvas or straw, and in cold weather with soil. When they are wanted in the factory, a stream of water is let into the upper end of the bottom ditch. The loose boards covering it are raised, and the beets are allowed to fall into the swiftly-running stream below, and are floated along to the houses. The water serves the double purpose of carrying and washing the beets.

At the end of the ditch the beets are caught by buckets arranged upon the rim of a large revolving wheel, which lift them out of the dirty water and deposit them in the washing machine. This is a large, wooden, auger-shaped affair, lying horizontally in a round iron tank through which clear water is flowing. The revolving auger pushes the

SCREW ELEVATOR AT A BEET SUGAR FACTORY.

beets forward, rolling and tumbling in the water, and finally deposits them clean, in the elevating apparatus which carries them to the very top of the building. Here they are deposited into an automatic weighing machine which weighs half a ton of them at a time, and drops the beets into a slicer, a large wheel covered with knives, which revolves among the beets and cuts them into long, thin, diamond-shaped slices.

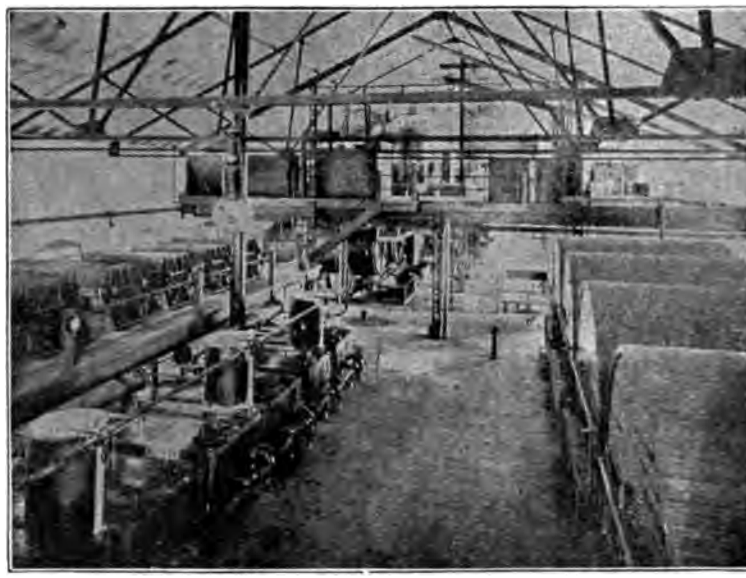
Immediately below the slicer, and upon the second floor of the factory, is a group of wrought-iron tanks that look like upright steam boilers, each large enough to hold about 3,000 pounds of the slices. These communicate with each other by means of large pipes. The first is filled with slices and water is then let in from a tank above. This is allowed to stand while the second tank is filling. Then the valves are opened into the next tank, containing fresh slices, and fresh water running into the first tank under pressure, forces the water which has already absorbed some sugar, on into the next tank, where it becomes richer. And so on from tank to tank it progresses, always tending to coax the sugar outside of the beet into the water. By a repetition of this process from tank to tank, the water gradually absorbs the sweetness from the beets and exhausts them of all the sugar to within one-tenth of one per cent. The exhausted slices are dropped from the tanks, and run through great rotary auger presses, and the partly-dried pulp is then shipped away for cattle feeding.

DIFFUSION BATTERIES.

The apparatus just described is called the diffusion battery, and when once started, fresh slices are supplied and juice is drawn off almost continuously. The juice is of a chocolate brown color, containing much organic matter not sugar. It is run from measuring tanks into tall, cylindrical vessels holding about 2,000 gallons. Here a thick lime solution is added, which takes out the coloring matter and other organic matter. Next comes a succession of boiling, filtering and clarifying processes, after which the fluid has become a moderately thick syrup ready to be boiled down to sugar. The boiling process is a delicate one, which must be handled with care in order to get the best results. The syrup is pumped up into vacuum pans, large cylindrical bodies, some ten feet in diameter, with oval top and bottom. Great copper steam pipes are coiled inside, and a large air pump with an eighteen inch cylinder keeps up the high vacuum and removes the evaporated water so that boiling down goes on rapidly, and at a very low temperature.

The sugar-boiler watches the mass through glass windows set in the sides of the pan, and when the small grains begin to appear, "feeds" them by adding fresh syrup until they are of the required size. When the grade is right and the water is evaporated sufficiently, the steam is shut off, the pump stopped, a valve is opened at the bottom of the pan, and the whole mass is allowed to run into the tanks below.

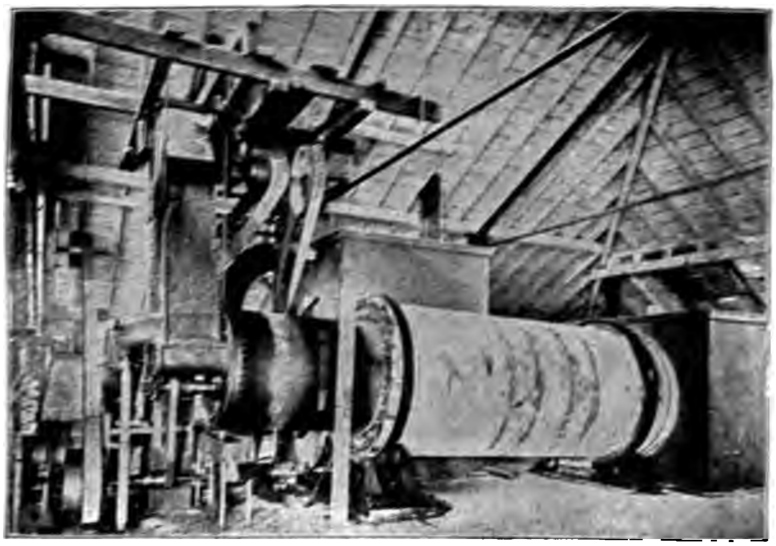
The syrup now looks about like dark molasses thickened with granulated sugar, and is so stiff that it will just run. This mass is drawn off into large whirling drums called centrifugal machines. These have their sides perforated with small holes, and are lined with gauze. The sugar rises up along the sides of the drums as they whirl, as water will in a revolving pail, and the molasses is thrown out of the holes in the sides, while the sugar too large to get through, remains sticking to the gauze. The sugar is washed by directing a spray of cold water and air against it as it whirls, and a little bluing is added to give brilliancy. The machine is then stopped, and the sugar, which is now white and moist, is dropped from the bottom of the machine, and conveyed to a large horizontal revolving cylinder heated by steam and called the "granulator." It is here dried, and the fine dust of sugar contained in the granulator is drawn out by a suction blower. The sugar passes through screens at the end of the granulator, which removes the large lumps, and thence to the bags for market.



CARBONATORS IN A BEET SUGAR MILL.

THE CENTRIFUGALS.

The molasses thrown off at the centrifugals is mixed with fresh syrup and boiled again, or is boiled alone and passed through the centrifugals, and the brown sugar resulting is refined by mixing with fresh syrup. A careful chemical control is kept upon the whole house. The laboratory has been called by one of the principal manufacturers, the heart of the factory. Here



SUGAR DRIER

everything is tested — beets, juice, syrups and boiled sugars. Every pound of sugar entering the house is known from analysis and every loss is located and accounted for. In the laboratory are tested also the coal, the limestone, and the coke, the amount of ash in the raw sugar, and the value of soils and fertilizers. The factories run day and night, seven days in a week, stopping only to clean up or in case of an accident. And the sugar rolls out from each factory at the rate of thirty, fifty or one hundred tons a day.

If a Michigan chemist realizes his expectations, saw mills in the pine forests of the north may become active competitors of the Louisiana sugar plantations. He declares that he can make granulated sugar out of sawdust, and that he can do it cheaper than Cuba, China, Germany or any other country can possibly produce it.

The Louisiana sugar plantations produce less than one-fifth of all the sugar consumed in the United States, which is the chief reason for the rapid stimulus of beet-sugar production. In our Louisiana cane fields the harvest begins early in October. The negro field hands first strip the cane of its leaves with the dull side of the knife, and then the tops are cut off as far down as the experienced cane cutter pleases and the maturity of the cane will permit. For while the sugar planter wants every inch of cane which will yield up sugar, he doesn't want to grind and handle an inch more than is necessary. The field hands begin work at daybreak, and cut enough cane during the day to keep the mill supplied for the suc-

DEFECATING PANS.

ceeding day and night. The cane is first weighed while on the wagon, and then dumped in the cane-shed, which is an open, heavily built wing of the sugar house. From the shed to the mill extends a traveling platform or conveyor. Colored women pick up the cane and spread it on the moving slats which carry it to the mill to be crushed. The roller mill is a ponderous piece of machinery, massive in all its parts, for sugar cane has a tough, hard skin, and cannot be crushed by tender methods. Sometimes nine rollers in succession are used to complete the crushing process. In the intermediate stage the crushed cane is called bagasse. When it is squeezed almost dry it is carried to the boiler room, for fuel, or it may be used for fertilizer.

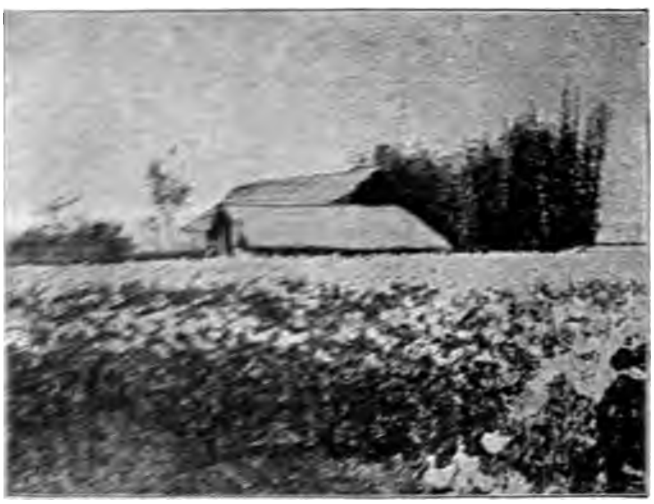
When the cane is crushed, the juice runs down, a greenish, sticky liquid, through a strainer, to a vat from which it is dumped to the clarifiers. Lime and heat are used in this process, just as in making beet sugar. The juice is boiled in a succession of open kettles, first to a syrup and then to sugar, being frequently skimmed of the impurities which rise to the top in the form of a scum, and are usually made into rum. When the tests show that the proper density has been reached, the heavy syrup is dipped into cooling-vats of wood, where the sugar is crystallized. Of late years vacuum pans and centrifugal machines have been introduced in the largest cane-sugar factories, like those used in beet-sugar making.

Enormous quantities of sugar are made in Cuba, Porto Rico, and the other West India Islands; in the northern countries of South America; and in the Dutch East Indies. Hawaii, too, has a large sugar industry. Germany and France are leaders in the beet-sugar industry; Russia and Austria are active in the same direction, and our own American farmers and sugar-makers are united in the development of the industry in this country.

CUTTING, STRIPPING AND HAULING SUGAR CANE.

OPIUM AND ITS PRODUCTION

[illegible] much to soothe pain in [illegible] and has put into [illegible] many a [illegible] of its in- [illegible] international [illegible] has been far from sooth- [illegible] English, French and Chinese blood [illegible] in battle, and the diplomats [illegible] three countries have used all their [illegible] settling the questions which have [illegible] In the politics of [illegible] the opium question has been



[illegible] POPPIES IN BLOOM.

[illegible] of its com- [illegible] powers. [illegible] has long been con- [illegible] chief cause of [illegible], and that [illegible] the French made war [illegible] merchants whose affairs [illegible] with by the opium monopoly. It has always been [illegible] against Great Britain that the war [illegible] China some forty years ago was in- [illegible] British desire to estab- lish the opium trade which has become the curse of the Chinese empire, and peace was permitted only when the Chinese yielded to the admission of the opium against which they had struggled so long.

Opium, as every one knows, comes from the poppy, of which many varieties flourish in our own flower gardens. The nature of the soil and the climate have great influence on the chemical qualities of the various plants, which are found in Persia, China, and more especially in India, where for a long time the English government has monopolized its culture as in France the government monopolizes the culture of tobacco. In all the immense and fertile valley of the Ganges, nothing is asked of the earth except the poppy. The districts of Patna and Benares are distinguished by the richness and abundance of their harvests. At the season's blossoming the air is saturated with a soft, enervating perfume, and nothing equals the monotony of an Indian landscape when the dried petals of the flower detach themselves and cover the soil. The product of this culture in the province of Bengal alone is estimated at 15,400,000 pounds which represents a value of $30,000,000.

Opium is extracted from the matter which exudes from the green, unripened capsule of the poppy. This matter is gathered in little globular particles of amber color, by means of a special instrument. It is put into earthen pots, carefully covered, and transported to the laboratories of the English government, where it is massed into balls about the size of a Dutch cheese. These masses are covered by the petals of the plant, which have been reduced to powder in order to prevent their adhering to each other. After being dried methodically, the masses are packed and sent to Calcutta, the market which supplies all Asia.

From this raw opium is made the finished product which is used by smokers. The process is a very delicate one, and only the Chinese know how to get the very best results. The raw opium is brought from Calcutta to the place of manufacture, to the opium-boiling establishments. The ordinary place of this kind contains four large boilers and 160 small furnaces, with basins constructed of masonry, in the form of a long bench. First the balls of opium are cut in half, and from the inside the raw opium is taken with the fingers. That which remains attached to the envelope of petals is afterwards secured by placing it in the boiling water. These preparations completed, the opium is placed in the basins with water, where it is boiled for two hours and constantly stirred until it reaches the necessary consistency, which nothing but long practice can determine. The worker seats himself on the ground, his basin between his knees, and with the aid of a small instrument works and kneads the mass before him, over and over.

The mass is now spread over the inner surface of the basin, which is tilted so that the direct heat of the fire is radiated against it. Under this influence, the external surface of the opium loses part of its moisture, and then becomes softer. The basin is then taken from the fire, and the cold air operating on the surface of the mass hardens it suddenly, while the part below the surface retains its paste-like consistency. The worker seizes the hardened crust and detaches it from the rest of the mass. The basin is then exposed to the fire again and a second crust is detached and sometimes even the third one. These crusts are then broken and placed in the basins full of water. In about twenty-four hours all the solid parts of the opium are separated and the liquor is filtered and evaporated at the fire to a sufficient consistency. After being exposed to the air the extract is put into copper vessels where it is left long enough to undergo fermentation which removes from it the acrid principles and permits it to acquire all of its necessary properties.

A CAMPHOR TREE.

The opium now presents itself in the form of a cake, brown in color like molasses, and exhaling an aroma difficult to describe. The precious drug is put into small metallic boxes of various sizes and at last is ready for the market at a price ranging from twenty dollars a pound upward, according to quality, taxes and import duties in the countries where it is consumed.

Of course its high price and the restrictions placed about the production and sale of the drug, account for the widespread theft and smuggling of it, with which all countries have to contend. It has its distinct value in science, but except for the medical and surgical uses to which it is put, it would be better if this insidious decoction of the innocent poppy were blotted out of existence.

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TOBACCO RAISING AND CIGAR MAKING

Of all the contributions which the western hemisphere has made to the world since the voyages of Columbus, probably no product has gained more universal use than tobacco. It is declared that there is no other luxury in the world for which so large a sum of money is annually paid and, indeed, it has been taken out of the list of luxuries and has become a necessity to many millions of people. It has therefore become in an industrial sense one of the most important products of agriculture and commerce.

An exploring party searching for strange things in Cuba, reported to Columbus on his first voyage, that they saw people who carried fire brands and perfumed themselves with herbs which they carried with them. On the second voyage the habit of snuff taking was observed. Tobacco chewing was noticed by the Spaniards on the South American coasts in 1502, and, as exploration advanced, it was found that tobacco smoking was common all over the new

CUTTING TOBACCO ON AN AMERICAN PLANTATION.

world, dating from time immemorial, and that it constituted an important factor in all tribal negotiations and religious ceremonies.

Francisco Fernandes, a Spanish physician, was sent by Philip II. in 1558 to ascertain the natural products of Mexico, and it was he who first took the plant to Europe. Jean Nicot, the French ambassador to Portugal, sent some tobacco to Catherine de Medici, and his name has been commemorated in the scientific name of the tobacco plant, Nicotiana. At first it was supposed to possess almost miraculous healing power. It went to Europe through Spain, but its use was introduced by the English. Ralph Lane is said to have been the first English smoker, and through the example and influence of Sir Walter Raleigh, the habit spread among the gentlemen of Queen Elizabeth's court.

There are many species of nicotiana, but those of which the leaves are used for smoking are few in number. These with but two exceptions, one a native of New Caledonia and the other of Australia, all are of American origin. The tobacco plant flourishes over wide areas, but is best suited for regions having a mean temperature of not less than forty degrees, where early autumn frosts do not occur, and where there is neither excessive moisture or drought. Tropical climates develop the finest qualities, where there is no excessive moisture. The tobacco plant absorbs its food from the soil very rapidly and leaves it in an exhausted condition. This makes liberal fertilization necessary and the character of the fertilizer exercises a wonderful influence over the quality of the tobacco.

There is a saying in our own southern states, that the cultivation and saving of a successful tobacco crop requires fourteen months every year. This is justified by the fact that actual work on the crop begins by January first, and continues with little intermission till March or even May of the following year. In addition to the actual cultivation, it involves a warfare on pests from the start.

About the first week in January the planter goes into the thick woods where there is a good southern exposure and picks out a place for the plant bed. Then the negroes set to work clearing the required space. After the square is thoroughly cleared it is covered with fertilizer and then the seed, which is like a quantity of ground black pepper, is sown over the ground and whipped in with a brush. Forty days' time is required for it to sprout. A little while after the seed is sown, the bed is covered with a flimsy cotton cloth to guard against the frequent changes of weather at that season and keep off the pests which would destroy young plants. Early in May the plants are large enough for transplanting into the field, which must be put in the very nicest order for their reception. The weather has much to do with success here, for it is only in a wet spell that sprouts will survive transplanting. The cultivation proper is not the most exacting part of the undertaking. The plowing or hoeing must be well, and even nicely done, but it extends over a period of only about six weeks.

When the plant is six weeks old it is topped to ten or twelve leaves, and almost immediately false leaves or "suckers" start at every joint, beginning at the bottom. As these detract from the proper growth of the leaf, it is necessary to go over the crop each week until cutting time, and pull off every new sucker that has been put out. As [illegible] A

CUTTING TOBACCO IN CUBA.

great many of the worms' brethren, also, and their progenitors, the tobacco fly, will be there. He is a big worm, and if he were to make his appearance suddenly on the floor of a house in a region where tobacco is not known, he would have possession of the place very quickly. But his appearance does him injustice. He is not as dangerous as he looks, and his only bad habit is tobacco. If left alone he would ruin a crop in two weeks after his arrival. But the little negroes do not leave him alone. They take him familiarly between a thumb and forefinger, and end his career at once. Planters offer a bounty of so much a dozen for worms taken from their fields, and a much greater reward is paid for the capture of the tobacco fly from whose eggs the worms hatch. There is no very great number of tobacco flies. A very few, say a dozen or so, would plentifully supply a whole plantation with worms, and so the early destruction of the fly goes a long way toward checking the pest. To accomplish this an occasional "Jimson weed" is allowed to grow in the field and when these are in blossom a small amount of cobalt mixed with honey is placed in the flower. As the fly feeds on the blossom, a very small amount of the cobalt is fatal to him.

In about ninety days after the planting, the tobacco is ready to cut. When ripe the green is dappled over with slightly yellow spots. For cutting, a strong knife is used. A large number of sticks about three feet long are then distributed over the field. One man holds the stick, while another cuts the plant, splits it near the base, and hangs it on the stick. Five to seven plants are placed on the stick, which then is laid on the ground to be taken up into the wagon following, and hauled to the barn.

The tobacco barn is a tightly constructed log building, about twenty feet square and almost as high. There are two furnaces inside, which are arranged to be fired from the outside of the building. There are sets of horizontal poles across the interior, from which the sticks of green tobacco are suspended. The barn holds about 800 sticks, probably the yield of a little less than an acre of ground. When it is full, the door is closed, and the fires are started, to be kept going night and day for four days. Beginning with a very low heat, it is increased to about 100 degrees by the end of the first twenty-four hours. Too sudden heat blackens the stems, and otherwise affects the color injuriously.

Beginning with the second day, the temperature is increased about a degree an hour, until 125 degrees is reached. It is held at this temperature for from eight to twelve hours, after which the thermometer is started up again, until 180 is touched, and the heat is held at that until the stem of the tobacco is thoroughly "killed." Then the fires are drawn, and a quantity of water is thrown in upon the ground, the vapor from which puts the now brittle leaf in condition to be handled without injury. Then the tobacco is taken out and stored away and the barn is ready to be filled again.

Firing or curing is a delicate and difficult task to do properly. It is necessary to replenish the fires and observe the thermometer every hour. Burning a barn and its contents on the third or fourth day is not infrequent. The heat becomes so intense that a spark sets it off with almost an explosion. Tobacco cured thus in closed barns is much lighter in color than that dried in the sunlight or in the open air. The lighter and evener the color, the higher the price it brings in the market.

After the curing is all done, comes a long-drawn-out task in which the men, women and children all participate—that of stripping the leaves from the stem and tying them into bunches or "hands." This task is not continuous, as often for two or three weeks at a time the leaf is too dry to handle. When the air is moisture laden it becomes as soft and pliable as a kid glove. As the stripping is done, the leaves are sorted by color into as many as seven different grades. When there are ten or a dozen leaves of one color and grade, they are secured by placing the stems together, wrapping an extra leaf tightly around them, and drawing the end between the other leaves. This is now called a "hand," and is the form in which tobacco is marketed.

It is now ready for "bulking" for fermentation. For this purpose it is piled or stacked upon the floor of the barn or dry house. Fermentation is quickly set up, and the temperature steadily rises to about 130 degrees. Care must be taken to prevent over-heating, and to secure uniform fermentation. This is accomplished by taking down and restacking, putting the top to the bottom, and the outside into the middle.

It requires from three to five weeks to complete this process, depending, of course, upon the quantity in the mass, and the atmospheric conditions. The leaves should now have a fine brown color, and can be left in the mass until the following summer heat sets up what is termed the May sweat, when it is necessary to give it careful attention again.

The net yield in money to the planter varies greatly. To insure success the closest attention is necessary at every stage of the work. A storm just before cutting-time sometimes damages the crop one-half. A bad job of curing, on the other hand, would take away nearly the other half. If the soil is very rich it is likely to add to the weight, but it more than counterbalances that gain by detracting from the quality. One Virplants are immune from insect pests, from the changes of climate, from the effects of the direct sun, and from many other difficulties which the planter ordinarily has to face. The coverings are strong enough to stand any ordinary wind, and the plants are not lashed and torn by the storms. Within the tents a continuously tropical climate exists. The leaves grow more luxuriantly, and the plants increase to great size. The tobacco with which these experiments have been made is the Sumatra product, for which this country has been sending annually the sum of $6,000,000 to the Dutch East Indies. The Sumatra wrapper is considered essential for cigarmaking, and the great profit produced by this successful experiment promises to keep this money at home instead of spending it for the imported product.

Hundreds of millions of cigars and cigarettes are burned each year, and the making of them supports an immense army of workmen, who supply the tools, boxes and labels and who roll the fragrant cylinders. The cigarmaking business is one of the few which holds at bay the labor-saving machine. Numerous efforts have been made by sanguine inventors, who saw fortunes in a practical machine, but the hands and fingers of the cigarmakers, aided by the simplest of tools, continue to roll and shape the tobacco leaf into the finished product ready for the smoker. Few trades require less in the way of tools than the cigarmaking industry. Give the skilled workman a hard maple board on which to roll his cigars, a knife, som- paste and tobacco leaf and he is well-equipped. But, like most trades where the fingers are the principal tools, the cigarmaking business must be learned from the very beginning. From three to five years are required to make a skilled workman out of a boy, and sometimes men cannot learn the business at all.

Cigar manufacturing may be divided into two general divisions, hand and moldmaking. There is considerable difference in a technical way between Spanish and American methods, but the difference comes in minor details, which would not be noticed by the casual visitor to a cigar factory. The fact is, nearly all ordinary cigars are made alike, whether the cigar box has a New York brand, a Key West label, or a Havana mark. The better class of cigars are the hand made, and most of the cheap grades are mold made. In either case the beginning is the same.

The tobacco leaf is moistened, stripped, separated into its grades, and "booked." This work is done by boys who are learning their trade, or by girls. The strippers tear the leaf from the thick middle stem, and if the leaf is to be used for wrappers or binders, they place the spread-out leaves, one over the other, into a book. Before the leaves are stripped they are moistened by being dipped in water, and laid away over night between damp cloths in a box. In spreading the leaves out for examination and stripping, some skill is required, for the stripper must know by the feel of the leaf just how much stretching and smoothing it will stand before tearing. This is a trick of the trade which can be learned only by experience. The stripper does more than this, however, for she separates the leaf into the various grades, and boys are set to work stripping, because they thus not only learn how to handle the leaf, but learn the fine distinctions between "wrappers," "binders" and "fillers."

The filler is the core or the body of the gives the cigar a more cylindrical shape, but puts a sort of polish on it.

In cutting the wrapper the cigarmaker endeavors to leave out the thick veins. The wrapper is cut or trimmed twice, once to give a narrow strip, and the second time for the "head." The head is not cut out until the wrapper is on the body of the cigar and the workman is ready to twist the point. Then he cuts the wrapper in such a way that it will twist up to the point, but before the point or head is made, he puts on some gum to hold the point in place. The cigar is then cut to the right length, rolled, and laid to one side finished. The process just described is generally called the "German hand-made" process. It is the one commonly used in the smaller shops in Chicago.

Mold-made cigars call into use wooden molds which press the "bunches" to shape, ready for the wrappers. The molds are made of two pieces of wood in which cigar-shaped recesses are cut. Less care is used in bunching the filler and wrapping on the binder, for the mold gives the shape. The partly made cigars are placed in the molds and squeezed for an hour or so in a press. Then they are turned half way round in the molds and pressed again, and when taken out are "rolled" and cut to length. Two hundred and fifty cigars are a good day's output for one workman on hand-made goods, but 500 cigars have been made in one day by one cigarmaker working with molds.

Spanish handmade cigars are made without binders, for the workman spreads out each leaf of the filler in the palm of his hand and twists them to shape and puts on the wrapper almost in one motion.

After the cigars have been laid neatly in rows in the cigar box the lid is closed over them and the box is put in a little screw press, which jams the cigars down snug enough to permit the lid to touch the wood, for the cigars more than fill the box. Then a number of boxes are placed in a larger press, a board is laid over the top row, the screw is turned down upon the board, and all of the boxes are kept in the press over night. Then the lids are tacked down and otherwise fastened, and the cigars are ready for the "trade."

HOW TRUNKS ARE MADE

Travelers need more than trains and steamships to make their journeys pleasurable. They must have their baggage with them, and thanks to the assaults made upon it in transit by their eternal enemy, the baggage master, they must see to it that trunks and valises are strong enough to stand the shocks to which they are submitted. It has been suggested that the men who make trunks and the "baggage smashers" who apparently attempt their destruction, represent two great industries in a state of mutual antagonism like that which exists between the makers of armor plate, the builders of hundred-ton guns, and the inventors of high explosives.

The trunk-maker selects for the body or box of his trunk, sheets of thoroughly seasoned basswood. This may be used solid, or in veneers glued with the grain of alternate sheets at right angles. For the best trunks the veneers are used, and are glued together so strongly that it is almost impossible to separate them. The nails used in fastening the box together at the joints and angles are of steel wire, coated with gum to increase the holding power.

siderable expense and by not many manufacturers, the name being a synonym for the highest grade. The first raw-hide trunks made in the west were built out of buffalo hide for a Chicago wholesale house twenty-five years ago, and those identical trunks are still on the road, packed with dry goods samples.

Trunks are made out of basswood, tin, sheet iron, sole leather, canvas, split leather, willow, rattan, paper and pine. The commercial traveler is the trunk-maker's best customer. These traveling representatives of wholesale houses use trunks to carry all sorts of things. A trunk was made recently to carry an iron safe for a sample. A musical instrument house in Chicago orders trunks large enough to hold a complete organ, and traveling men for a stove house carry full sized samples of their goods in trunks. The large trunks for bicycle salesmen have become an important part of the product. Theatrical companies likewise are among the best customers of the trade.

Valises and traveling bags of various sorts, of which the dress suit case is the most recent and popular form, are likewise made in great number at the trunk factories. The finest leathers are used and in the more expensive grades such traveling bags are fitted with silver and cut glass toilet utensils and all the equipments of a lady's boudoir.

For making high grade trunks and valises, high grade labor must be employed. It is declared that expert workmen in such occupations are paid the highest wages earned by any mechanic or bench laborer in any manufacturing line in the United States.

MAKING VALISES AND TRAVELING BAGS IN A TRUNK FACTORY.

SCENE IN THE REMARKABLE SALT FIELD IN SOUTHERN CALIFORNIA.
Salt comes ready for the mill after the Indian laborers have washed it.

SALT AND ITS PRODUCTION

It would be difficult to name anything more universally required by mankind than the common, cheap and simple substance which we call salt. Indeed, not only mankind, but animals as well, find it essential to their health and will undergo any difficulties necessary to obtain it. Fortunately for the world there is nothing more generally found and nothing cheaper. The ocean, which occupies approximately three-fourths of the surface of the globe, holds inconceivable quantities of salt, carried into it by the rivers which it receives, and absorbed from the salt beds upon which it rests, and this supply in the greatest of storehouses is never diminished by evaporation. On land, underground and surface deposits of salt alike are found the world over, and great inland bodies of water are saturated with this simple substance, which they are ready to yield at the demand of the salt-gatherer. Salt is obtained in ways that differ as widely as do the localities where it is found. Perhaps the most picturesque and interesting of all the salt gathering industries is found in our own country, recently developed, but already taking an important place in the production of salt for the market.

Away down in Southern California in the middle of the Colorado desert, about 100 miles from the ocean and eighty miles from the Mexican boundary line, is the little station of Salton, on the Southern Pacific Railway. It lies between the San Bernardino and the San Jacinto ranges of mountains. Between these ranges the valley sinks to a level some 400 feet below the level of the sea, making it the most depressed spot in the United States. In this remarkable depression, a short distance to the south of Salton, is a field of crystallized salt some 300 feet below the level of the sea and more than a thousand acres in extent. Here the company owning the tract employs a number of laborers in the gathering of salt for the market, by methods genuinely unique.

GATHERING SALT IN MEXICO.

The salt itself exists as a crust over the surface of a marsh. It is constantly supplied by salt springs which flow from the

A DRY SALT SEA IN THE DESERT.

surrounding hills draining into the basin, where they rapidly evaporate, leaving the deposits of almost pure salt. The salt crust thus formed varies in thickness from ten to twenty inches.

The process by which the salt is collected is simple in the extreme. The crust is plowed by a salt-plow, resting on four broad-tired wheels and managed by two men. A railway track runs across the salt field at either end at right angles to the direction in which the plowing is to be done and a locomotive works back and forth on this line. From it steel cables are carried around pulleys and then hooked on to the plow, and the locomotive moves away, drawing the peculiar implement the full length of the field. The heavy steel share makes a broad furrow but a shallow one, leaving parallel ridges on the crust on either side. Between the wheel tracks the brine is exposed that seeps from the underlying salt springs. Laborers with hoes work the salt in the water to separate the earthen particles that have adhered to it, and when this is done they stack up the clean salt in conical heaps ready to be hauled to the mill. The water in which this washing process goes on is itself so saturated with salt that it can absorb no more, so that there is no loss by the washing.

The surface of this remarkable field of salt is snow white, and its brilliancy in the clear light of the California sun is so dazzling that laborers have to wear dark glasses to protect their eyes. These laborers are either Japanese or Indians, for no white man can stand the intense heat. For weeks at a time the temperature averages 140 degrees, and the uninterrupted sunshine reflected from the dazzling white surface produces a glare that is almost intolerable. Even the Japanese laborers confine their work to the sewing of the sacks in which the salt is packed. The field work and the work in the mill are done entirely by Indians of the Coahuila tribe.

In order to supply additional water for washing the salt the company sunk an artesian well to a depth of 900 feet. Even this is still strongly alkaline, but it is the only source of water for domestic purposes. The air, laden with impalpable particles of salt, stimulates an intense and painful thirst which the workmen find it impossible to quench with the lukewarm water of the artesian well.

Out of this field of 1,000 acres of virgin salt, not more than ten acres are worked at this time, and yet from such a small portion about 700 tons of salt can be plowed and shipped daily. As fast as the crust is removed a new crust forms almost immediately after the plow has passed on.

AT WORK IN THE SALTON SALT DEPOSITS.
Indian laborers plowing, and, in background, loading salt on flat cars.

The drying and milling works are at Salton. After the salt has drained in the conical mounds in the field, it is loaded on flat-cars and hauled to the works. Here it passes through a mill which grinds it to powder and then it is sifted and packed into sacks for the market, in which it is recognized as of the best quality.

Under certain atmospheric conditions this salt field displays remarkably perfect examples of the phenomenon known as the mirage. Beautiful flowering fields, sylvan lakes and towering cities appear in most deceptive form. The effect of moonlight on the white expanse is singularly weird and beautiful.

The salt deposits of the ocean itself are utilized as a source of commercial supply in many countries, and particularly in the islands of the sea where other supplies do not exist. Even on our American coasts, however, the business possibilities of this industry are not neglected, and in the neighboring islands of the West Indies many people obtain their living by gathering salt. The process is to prepare a series of shallow pools near the ocean and below the level of high tide. Channels are cut by which the ocean water can enter these pools, and the channels are then dammed up so that the water cannot flow out when the tide recedes. After evaporation has left the ground white with dry salt, it is raked into heaps and hauled to the place of shipment, while a new period of evaporation is passing in the refilled pools.

In New York, northern Michigan, southern Kansas, southwestern Ontario and several other regions of North America, there are underground deposits of rock salt of great value. The usual process by which this salt is obtained involves the boring of wells deep into the strata of salt. These wells fill with water, either from the surface drainage or underground springs, or are pumped full, and the water dissolves the salt until it is saturated and becomes a brine. Then it is pumped out and evaporated in great kettles. In several European countries there are mines of rock salt, extending far underground, which are worked by shafts and tunnels in the earth, just as coal or iron mines would be. Austria and Russia have mines of this character, and they are considered among the most interesting of all the underground industries.

Mexico in several places has salt deposits similar to those in southern California, although none so extensive. Indeed, there is hardly a country in the world which does not contain salt deposits of some sort, even if in some instances they are no more than flowing springs impregnated with this important substance.

When we say salt we mean, usually, chloride of sodium or common table salt. This, however, is but one of many soluble salts contained in the ocean and in the salt seas of the world. Even in fresh river water some mineral salts are present. Of these a part may be removed by various means during the journey of the river, but the rest remains to be concentrated at last in the basin in which the river comes to an end. Of course in most instances the ultimate outlet of the rivers is the ocean and when this is not the case whatever outlet is final is sure to be salt.

There are not very many salt lakes in the world, or lakes without an outlet. North America has one such important

PLOWING FURROWS IN THE FIELD OF SALT.

lake, the Great Salt Lake of Utah, into whose basin drain a number of rivers included between the Rocky Mountains and the Sierra Nevadas. Asia has two or three of the same character, notably the Caspian Sea, which is the largest land-locked body of water on the globe, and nearly five times as large as Lake Superior. Lake Balkash, the Sea of Aral and the Dead Sea are others in the Asiatic continent, the latter being one of the few at a lower level than that of the salt deposit in southern California.

It would be easily possible indeed for this American salt field to become another Dead Sea. It lies far below the level of the ocean, as has been said before, and the Colorado River, which carries a considerable stream, is several hundred feet above it and not far away. In the summer of 1891, indeed, there was a flood in this river and a large area near Salton became a lake of considerable depth. When the river flood subsided, however, so that the supply of the lake was cut off, the rapid evaporation from its surface soon carried away the water, and left it in its former condition.

The saltness of the sea is evidence of its power of transportation if not of destruction, for at least a very large part of the salt is brought down into the sea by rivers. This, however, must be uniformly distributed by diffusion or by currents, for ocean water is practically the same composition in all parts of the globe. True, it is a little more salt in warm regions than in cold, but this difference is due to the greater amount of evaporation. For a time, also, it is more brackish, at any rate near the surface, in the neighborhood of the mouth of a large river. That the mineral substances must be mainly if not wholly brought down in solution by the rivers, is proved by the fact that every sheet of water for which there is no outlet is salt. Evaporation cannot remove the salt constituents, which are present in greater or less degree in every stream, so they remain behind and the water very slowly but very surely becomes more salt.

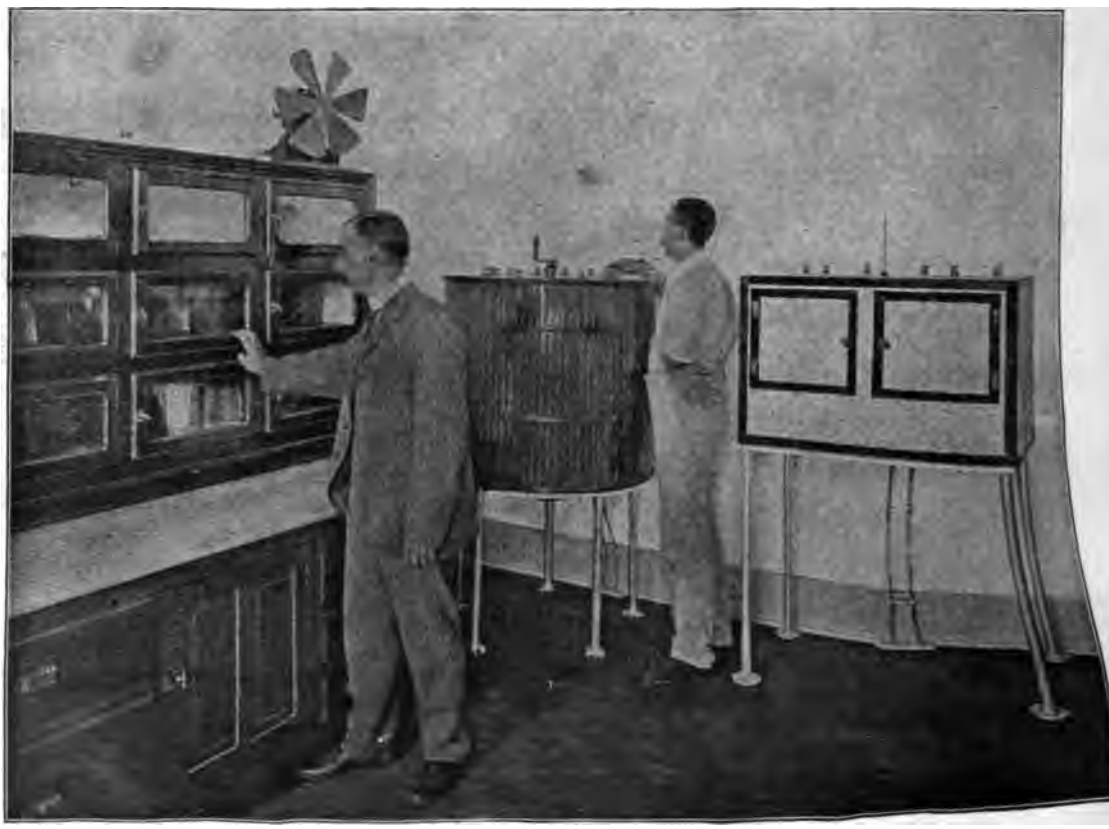
There was a time, as is proved by the character of the fossils which are found in beds high above the present level of the water, when the Dead Sea was but slightly brackish. The ocean, also, may be more salt at the present time than it was when the world was young. It would become much more so if countless millions of minute organisms were not ever drawing from it the supplies which are needed in the construction of the solid parts of their bodily frames.

The Dead Sea is recognized as the most fully impregnated with salts of all the bodies of water in the world. Less than 74 per cent of its entire bulk is water, and more than 26 per cent is of salts held in solution. Chloride of sodium, however, or common salt, is not the dominant salt, chloride of magnesium being 16 per cent of the total bulk of the sea, while common salt is but 3½ per cent. Our own Great Salt Lake, in Utah, stands at the head of all in the amount of chloride of sodium in solution, with nearly 12 per cent dissolved in it.

It is this large proportion of salt in the water which gives to the Dead Sea and the Great Salt Lake their extraordinary buoyancy. In these bodies of water it is absolutely impossible for the human body to sink, and difficult to swim, so dense is the saline fluid.

silk gauze, the meshes in which vary in size for the wheat from each set of rolls. The crushed wheat is thrown at the sieves by centrifugal force, and many impurities are removed. A new German machine, known as the plansifter, was introduced in a Chicago mill, and since that time it has been adopted by many first-class millers. It consists of a long, flat box full of sieves set at an incline, and perforated with graduated meshes. The whole device is given an eccentric motion by being fastened a few inches at one side of the center of a great wheel. By this means of jolting it the crushed wheat is rattled through the sieves and graded according to the size of mesh through which it passes.

The middlings, or crushed wheat, is now carried on to the middlings purifier, the invention of which a few years ago revolutionized the whole art of milling. Its work is to remove the impurities and bran from the flour. It accomplishes this purpose by subjecting the passing stream of middlings to air blasts of varying force. The light dust and bran are carried upward and caught in little pockets, and the purified middlings pass back to the second set of rollers, where they are crushed again. This circuit of processes—the rollers, the plansifter and the middlings purifier—is repeated five different times and the separation and grinding is then complete. The flour from the last process is carried down-



BAKING BREAD BY ELECTRICITY.

stairs, where it runs into sacks and is tied up ready for the market.

One of the most important machines in a mill is the dust collector. Before it was invented the air of the mills was always full of flying particles of flour, which sometimes exploded with all the force of gunpowder. The dust collector consists of a fan, which, in creating a vacuum, sucks the flour out of the air and deposits it in a chamber by itself. This dust can be used in inferior grades of flour.

A barrel of flour will make about 260 pound loaves of bread. If the combined bakeries of Chicago use 2,000 barrels daily the number of loaves made is 520,000, which, at a retail price of 5 cents, cost $26,000 daily. Probably as much more bread is made in the homes.

American flour is now used in almost every part of the world. A story is told of a traveler who visited the South Sea islands for the purpose of describing the terrible depths of barbarism in which its savage inhabitants were supposed to live. He secured an interpreter and began his explorations. When they reached the first bamboo and thatch village the traveler stopped on the roadside to experience feelings of wonder and exultation. He had heard that few white men had ever visited these particular savages, and like every person who believes his eyes behold unknown wonders, his spirits rose to a high pitch. He entered the village and was taken to the chief's bamboo hut. Just as he approached the door he was transfixed with amazement bordering on horror. There beside a long war club, the sword of a swordfish, and a primitive tom-tom, stood a real American barrel with a colored sign on the top advertising so-and-so's flour from Minneapolis, Minn.

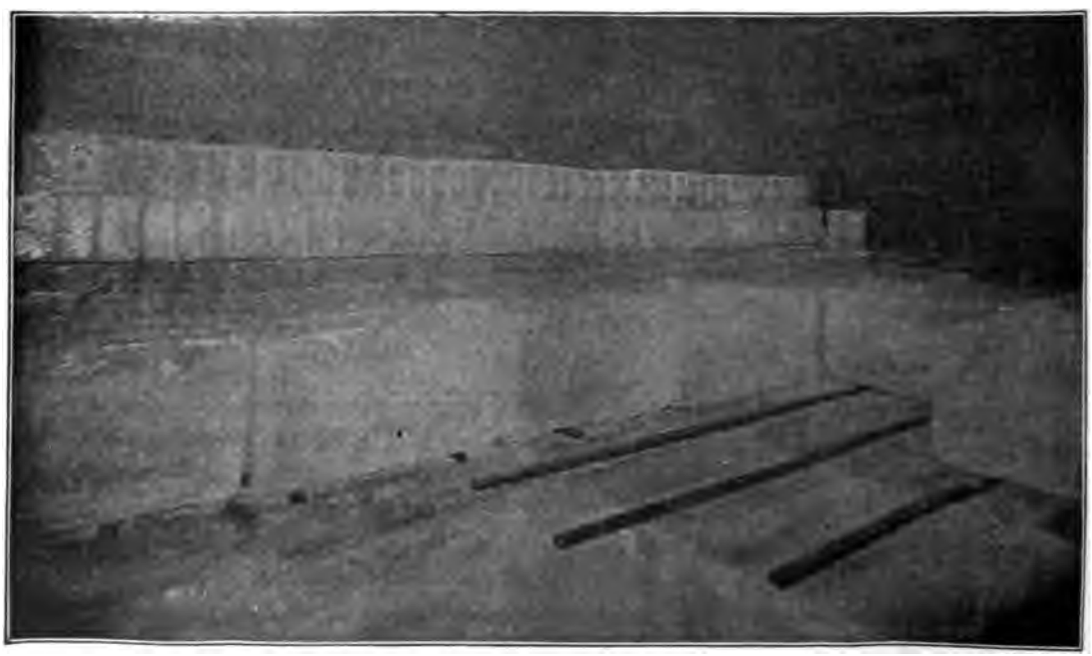
According to the census of 1890 the number of flour mills in the United States was 18,470, with a capitalization of $208,473,500. A total of 63,481 men were employed, and their wages reached the sum of $27,035,742. The value of the wheat which they ground was $434,152,290, nearly all raised in the western states, and the flour produced worth $513,971,474.

The largest number of mills in any one state was 2,226 in Pennsylvania, but Minnesota, with only 307 mills, ground $52,383,867 worth of wheat to Pennsylvania's $33,238,981. The largest value of wheat used, next to Minnesota, was $44,890,115 in New York. Then followed in regular order Ohio, Pennsylvania, Illinois and Missouri. Illinois had 647 mills, with a capital of $13,101,860 and produced $37,974,885 worth of flour in 1890. The census figures show that the products of the flour and grist mills of the country exceed in value that of any other single product from the raw material, even the iron, steel and lumber industries. The sugar-refining industry, which has caused so much anxiety on the part of congress, represents in value of annual products less than one-fourth that of flour-milling. The meat and packing industry, which seems so tremendous, does not produce as much as the flour-mills within $80,000,000 annually.

A noticeable thing about the industry, is the fact that the village mill is gradually disappearing. The wealthy and powerful millers of the cities are slowly swallowing up the business. This is strikingly shown by the fact that according to the census of 1880 there were 24,338 mills in the United States with a capitalization of $177,361,878, while in 1890 the number of mills had decreased to 18,470, while the capitalization had increased to $208,473,500. If this startling change continues it will be only a few years before half a dozen millers will control the whole industry in the United States.

ICE, ARTIFICIAL AND NATURAL

There is no article more intimately associated with our genuine comfort in the hot, trying weather of midsummer, than ice, which is now so universally distributed as to be recognized as no longer a luxury but a necessity. Ice is an essential factor for health and comfort, particularly in the cities, where people live crowded together, and the refreshing conditions of rural life are not at hand. The result of this wide use of the transparent blocks of frozen water is that for its preparation and distribution an industry has grown up, so important as to have its influence upon municipal politics and state legislation, and so profitable as to make fortunes for those who are engaged in it. In our northern states, nature by her own processes will make ice in the winter, enough to serve for the summer, if it is properly preserved, but in the southern states of our own country, and in the tropics, nature's gifts do not take this form, and man must provide cold things for himself. So it is that inventors have devised simple machines which by chemical and mechanical processes produce ice at little cost, whether it be on the equator or not. So excellent is the ice thus frozen that great ice-manufacturing companies have been established in the northern cities as well, competing in price and quality with those companies which distribute nature's own product.



ARTIFICIAL ICE IN STORAGE.

It is an old scientific trick to freeze water in the fire, by wrapping a small bottle with a rag soaked in ether or chloroform. The heat of the fire evaporates the volatile ether so quickly that the ether sucks the heat out of the water and freezes it. This is practically what the icemaker does, only he uses ammonia or sulphurous oxide, instead of ether or chloroform, and works on a big scale with large pumps, steam engines, and miles of iron pipe.

At ordinary temperatures ammonia is a vapor or gas. The ammonia which is bought at a drug store is really ammonia water, for it is a water in which ammonia gas has been dissolved or absorbed. The icemaker uses ammonia gas, sulphurous oxide—which is the choking, suffocating fumes given out when sulphur is burned—or ammonia water, according to the system he employs. Anhydrous ammonia is ammonia without water in it, and the icemaker who uses ammonia, buys anhydrous ammonia.

The whole story of artificial icemaking can be told in a paragraph, for it is simply permitting pure liquid ammonia to evaporate or expand inside of iron pipes which are coiled in tanks filled with salt brine, which gives up the heat required by the ammonia in evaporating, and thus lowers its temperature below the freezing point. The fresh water is in smaller cans which are surrounded by the brine, and is frozen, for the brine does not freeze even at zero.

But to do all this, expensive, heavy and special machinery must be employed, and the combination of steam-boilers, pumps, condensers, tanks, pipes and other machinery gives a complicated appearance to an artificial ice plant which is confusing.

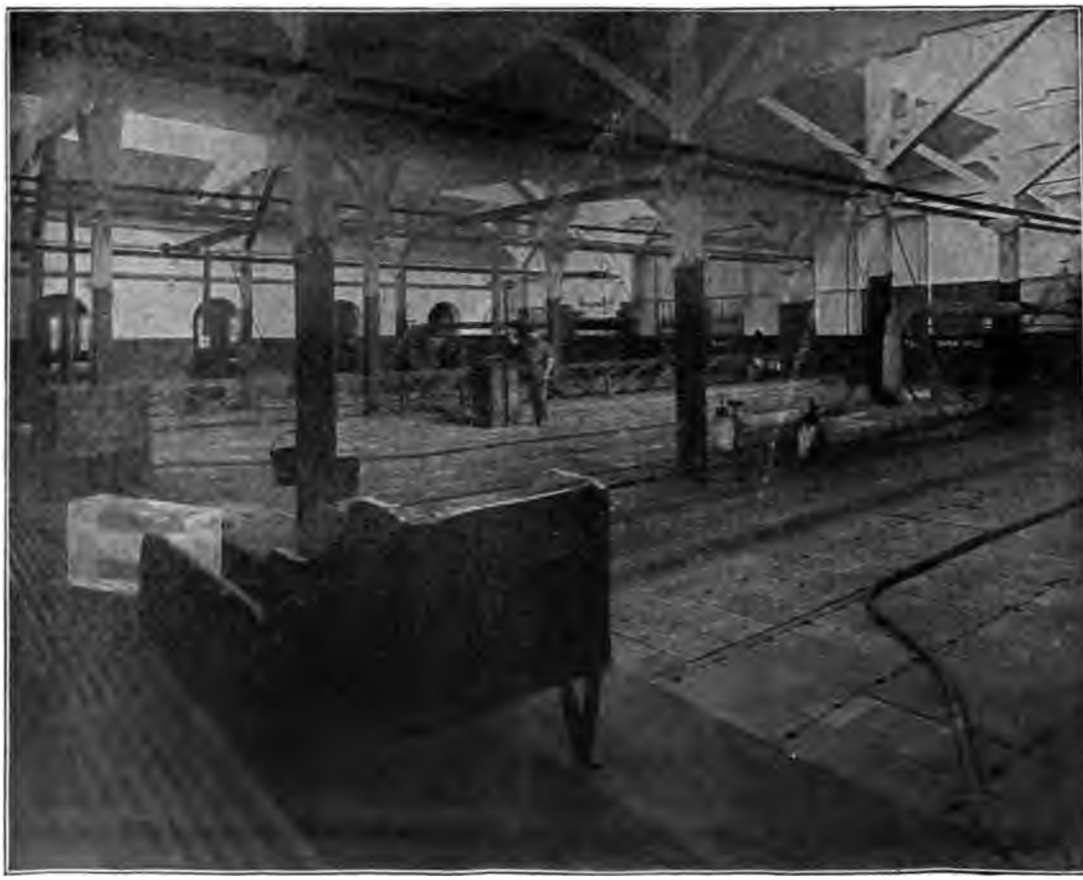
The great pump is the principal piece of machinery in the ice-making establishment. It performs a double office, for with one stroke of the piston it sucks in the anhydrous ammonia gas, and with the next compresses the gas to a liquid, for the anhydrous ammonia is used over and over again, first as a liquid, then as a gas, freezing water, and back as a liquid again. The ammonia gas is liquefied not only by pressure but also by cold. In an ice-making plant both are used. The pump forces the gas into the condenser, which is a series of coils of small pipe over which water is constantly flowing. The gas, pressed into the smaller pipe, turns to liquid ammonia. As it condenses, the liquid ammonia flows into a storage tank through small pipes leading from the condenser. All this time it is under pressure which forces it along, so that the liquid ammonia flows from the storage tank, which is placed in a horizontal position, into two large vertical cylinders, and from there into the expansion coils, which lie in the bottom of the expansion tanks. The pipes of the expansion coils are much larger than the pipes which make up the condenser, and the liquid ammonia expands and evaporates as it moves along, keeping the salt water or brine in the freezing tanks at a temperature of 18 degrees or colder.

All this time the big pump is pushing the liquid ammonia along, and sucking the ammonia gas back again, so that the ammonia, whether gas or liquid, is moving around, condensing, expanding, freezing, condensing again, expanding again, freezing again, and so on.

In making artificial ice the manufacturer wants pure water. To be certain that the water is free from sediment, typhoid germs and other impurities he filters and distills the water before it is frozen. In some ice works the water is filtered once before it is distilled and twice afterward.

The freezing tanks are made of iron. They usually are set below the floor, for the purpose of facilitating the handling of the ice. The tanks are about 50 feet long, 20 feet wide and 4 feet deep. The cans in which the distilled water is frozen are 44 inches by 22 inches by 11 inches in size. The pipes which contain the anhydrous ammonia go back and forth across the tank between the cans, and the salt water brine is kept in motion by an agitator somewhat like a screw propeller. This gives the brine an even temperature. It requires from forty-eight to sixty hours to freeze the water in one of the cans.

The cans are covered while the water is freezing, so that the whole process of freezing is really going on under the floor, for the covers are the plates of the floor. Over the freezing tank is a traveling crane, with a block and tackle for hoisting the cans with the frozen blocks out of the tank. The cans are lifted so that when they are clear of



FREEZING TANK ROOM IN AN ICE FACTORY.
The tanks are shown in the floor, each with rings by which they are lifted.

the tank they tilt upside down. They are then carried by the traveling crane to the head of a gangway which runs into the icehouse. Here streams of tepid water are directed upon the can. In a few moments the ice holding the cake to the can melts, and the block of artificial ice slides out of the can and down the gangway. The can is then taken back, filled with water, and dropped into the tank again.

Where shafts or tunnels go through quicksands artificial refrigeration is sometimes used to freeze the treacherous material. The anhydrous ammonia plant is on the surface or at the mouth of the tunnel, and from it brine chilled to zero is sent through pipes to the place of working. Pipes are driven ahead of the work into the quicksand, and the circulating brine freezes the loose ground into a hard cylinder. The work is then carried on through this frozen material, which shuts out the quicksand until the brick is laid in.

Fortunately nearly every city and town has some lake or river near by where ice can be cut in winter. The lakes of Michigan, Wisconsin and Minnesota, filled with pure water as they are, furnish a large quantity of the ice used in Detroit, Chicago, Milwaukee, Minneapolis, St. Paul and the other smaller cities within their territory. During the winter season busy scenes may be observed at these lakes, which are the favored resorts of multitudes of summer visitors in vacation time. Their frozen surface is alive with men and teams cutting the ice, rafting it to shore, and turning it over to the sleds that haul it to the railway for shipment to the ice houses.

There was a time when people were more careless about the health conditions of the food and its surroundings than they are now, but it has come to be so clearly recognized that many of our bodily ills come from carelessness in the sanitation of our houses and in the freshness of our food, that people now scrutinize these details with great care. Ice made from impure water is no longer acceptable for our refrigerators or our drinking water. Laws have been passed protecting the public in this matter, and their rigid enforcement has assisted materially in reducing typhoid and kindred diseases.

IVORY, HOW OBTAINED AND USED

Every ivory billiard ball in use in the world is said to have cost the life of a human being. And still the demand for ivory, not only for the manufacture of these simple spheres for a popular game, but for a multitude of other uses in decorative and toilet articles, continues, with the price so high that the trade still goes on in spite of its disastrous cost in human life.

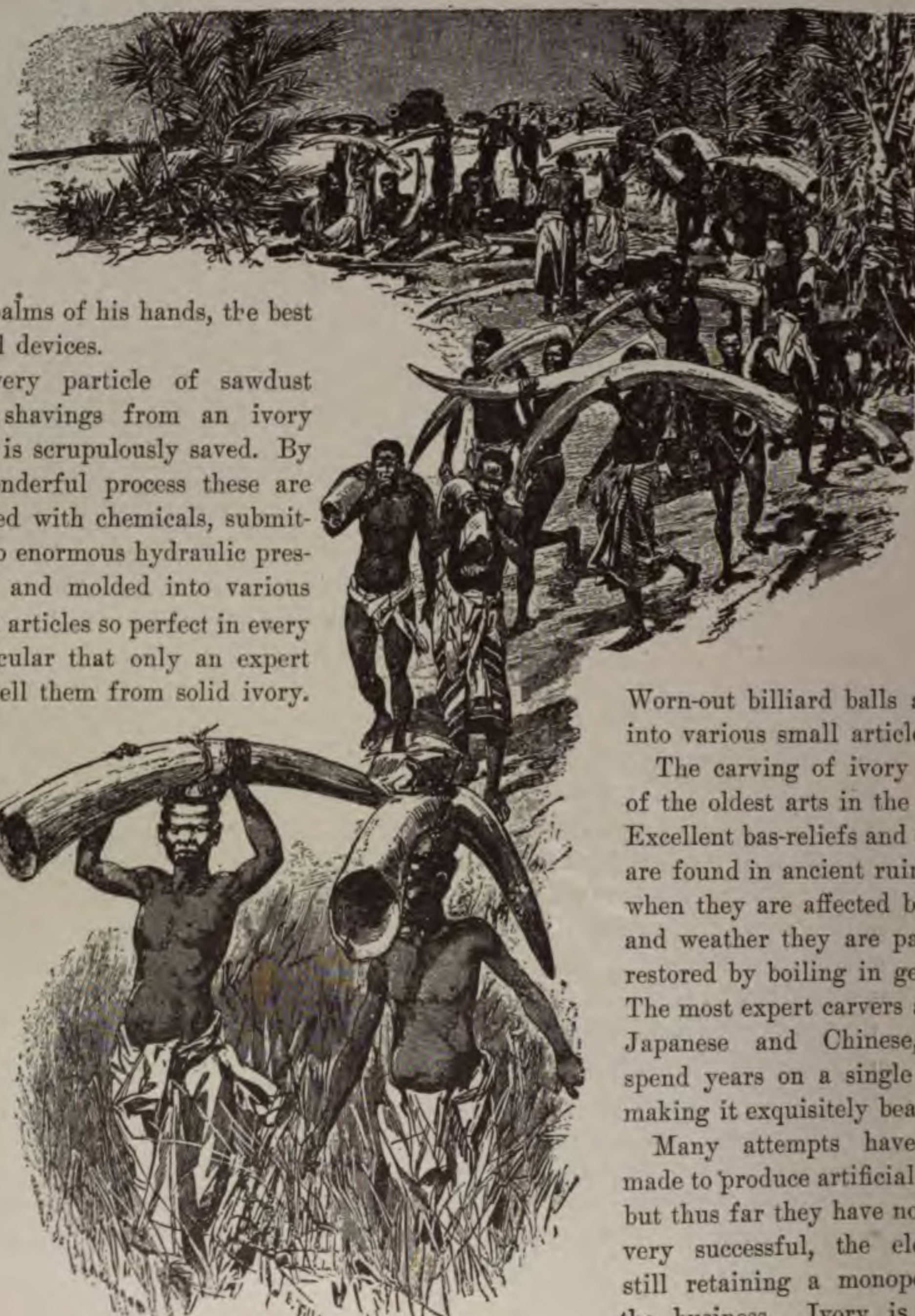
Most of the heavy expense has been paid in the jungles of central Africa, where a man does not count for half as much as a humped ox or a trained ape. For nature has built an effectual barrier about her cultivators of billiard balls—the elephants—and he who would penetrate it must take his life in his hands.

In the first place she has provided an atmosphere of great heat, reeking half the year with moisture, in which lurk the germs of a hundred unnamed diseases, and rent for two seasons with sudden storms accompanied by heavy rains. Then there is the barrier of a rank and tangled vegetation, through which no roads but those of the jungle-folk have yet pierced. The huge trees conceal fierce wild animals, poisonous snakes, and insects whose stings mean death at the end of the days of suffering. Impassable morasses, lakes, broad rivers and mountain ranges are also numerous, and yet more dangerous are the jealous savages, who have learned enough of civilization to distrust it, and who know that a man never protests against robbery after he is dead.

IVORY MARKET AT ANTWERP.
Tusks displayed ready for buyers.

So the elephant is given a chance to grow a little before the harvesters of the ivory crop can reach him. When he has trumpeted for a few score of years, and his tusks have made him a power in the herd, some native hunter spies him as he thrashes through the jungle or wades in a morass. Then a great number of the bravest warriors gather and build a huge inclosure of vines, into which the elephant one day walks. From the surrounding trees come a shower of arrows, and perhaps a bullet or two from an ancient gun obtained at a hundred times its value from some wandering trader. The elephant charges about trumpeting, but on every side the barrier holds him in. At last he falls, overcome by numbers. Then his great tusks are packed away, and a row of naked natives carry them for days through the jungle, until they are placed in the king's treasury as a part of the wealth as well as the currency of a nation.

After a time traders from England and from other countries appear, and the tusks are bartered for bright nothings, old-fashioned and shop-worn fabrics, food, whisky



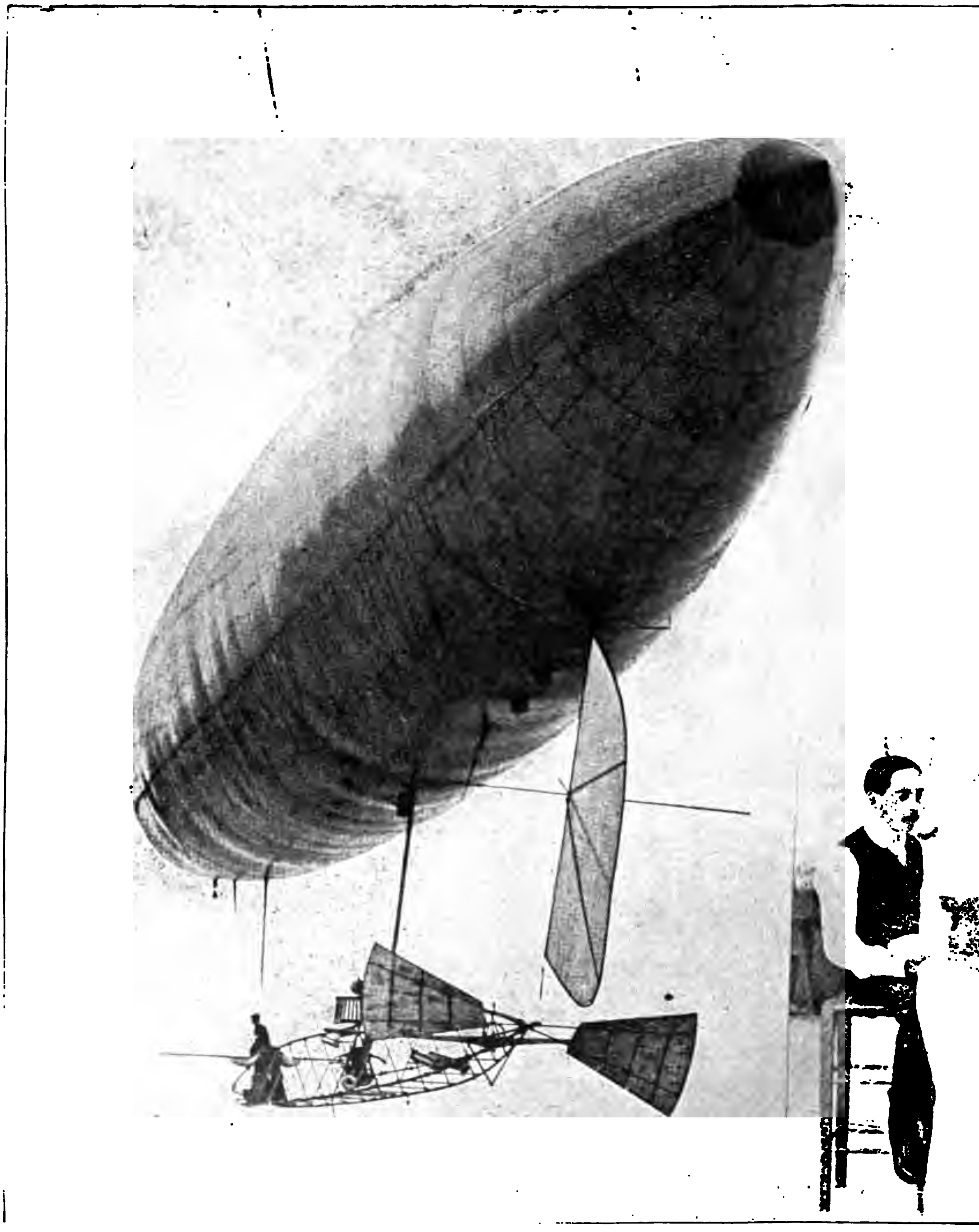
the palms of his hands, the best of all devices.

Every particle of sawdust and shavings from an ivory shop is scrupulously saved. By a wonderful process these are treated with chemicals, submitted to enormous hydraulic pressure, and molded into various small articles so perfect in every particular that only an expert can tell them from solid ivory. Worn-out billiard balls are cut into various small articles.

The carving of ivory is one of the oldest arts in the world. Excellent bas-reliefs and images are found in ancient ruins, and when they are affected by time and weather they are partially restored by boiling in gelatine. The most expert carvers are the Japanese and Chinese, who spend years on a single piece, making it exquisitely beautiful.

Many attempts have been made to produce artificial ivory, but thus far they have not been very successful, the elephant still retaining a monopoly of the business. Ivory is growing more costly and more rare from year to year, and it is only

BRINGING IVORY FROM THE AFRICAN JUNGLES TO THE COAST FOR SHIPMENT.



[illegible] AND HIS SUCCESSFUL AIRSHIP.

[illegible] No. 6," with which the young Brazilian inventor [illegible] winning the prize of $[illegible] In the small [illegible] airship was made, inspecting the [illegible] every inch of the whole vessel.

BOOK II

THE WORLD'S SCIENCE AND INVENTION

AIR-SHIPS A SUCCESS

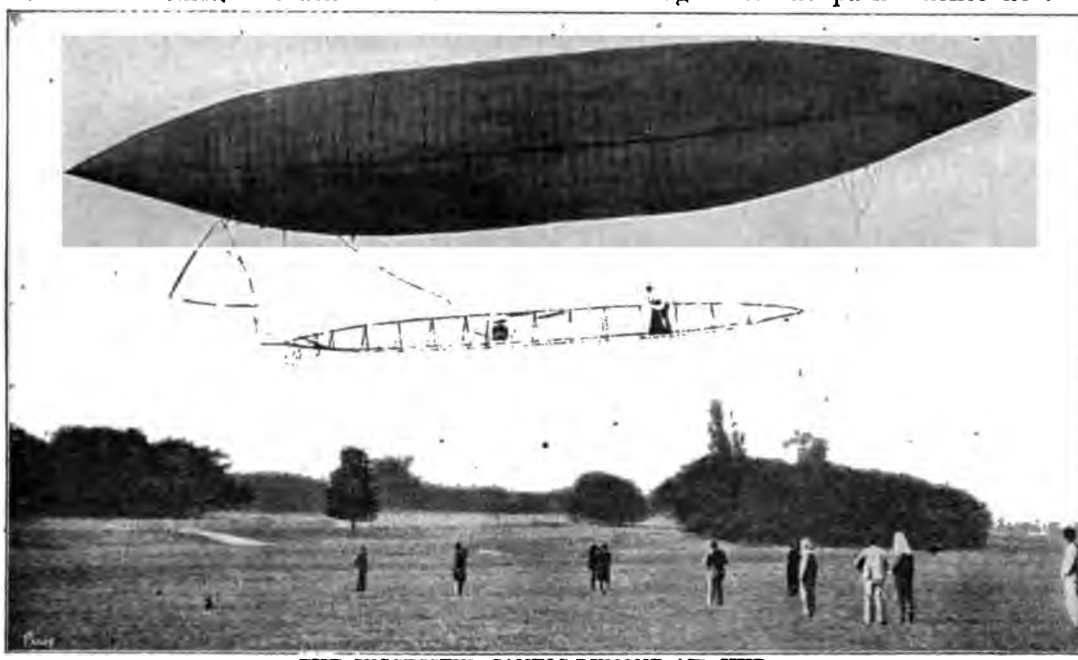
More progress has been made in aerial navigation within the last ten years than there had been before in the century that had passed since the Montgolfier brothers invented the first balloon. The most distinguished success has been made by a young Brazilian, M. Santos-Dumont, whose experiments, continued at great expense and with untiring energy for several years, at last brought him international fame. During his experiments in Paris in the summer of 1901, the young inventor succeeded in driving his aerial ship a distance of ten miles in forty minutes, and performed evolutions which showed that he had his craft under complete control during the trial. Paris has always been the center of activity in aerial navigation, and a large club of aeronauts has helped to stimulate general interest in the conquest of the air. One of the members, M. Deutsch, in order to stimulate invention, offered a prize of 100,000 francs ($20,000) for a successful balloon trip from St. Cloud around the Eiffel Tower and return in forty minutes. Various inventors worked for this prize, which was finally won by the young Brazilian, who gave the entire sum to the charities of Paris.

M. Santos-Dumont was born in Brazil in 1873, and as a very young man became interested in aerial navigation. His first experiments were with spherical balloons, but he soon abandoned these for those of cylindrical or cigar shape, and his triumphant success was gained with the fifth he constructed. The balloon proper with which he won the large prize, was 111 feet long and twenty feet in diameter. Beneath the

ROUNDING THE EIFFEL TOWER.

balloon, suspended by steel wires, was a cradle fifty-nine feet long, composed of pine poles secured together at the ends and braced in skeleton fashion like the trusses of a bridge. This cradle contained a four-cylinder motor of sixteen horse-power. The screw propeller of the strange craft was at one end, and at the other the aeronaut sat, in a small basket, in reach of electric connections which controlled the valves and rudder.

The start was made from the huge shed at St. Cloud, on the banks of the Seine River, near Paris. The sliding doors of the shed which sheltered the strange ship were opened at five o'clock in the morning, the craft was wheeled out into the open air, and the motor was given a turn. The ropes were cast off, the inventor took his seat in the basket, throwing out handful after handful of sand, and the balloon slowly rose higher and higher. The rudder worked well, and the balloon was turned upon its course directly toward the Eiffel Tower. The daring navigator rounded the great structure at a distance of not more than 300 feet from it, and at a height of some 500 feet above the ground. He returned again to the park whence he had started, without the slightest difficulty, brought the machine to the ground uninjured, and descended from his basket with the knowledge that he had outdone all his predecessors by this marvelous achievement. Never halting in his experiments, Santos-Dumont constructed another and yet another of his air ships, each an improvement on its predecessor, and continued his aerial voyages on the Mediterranean coast and at other places in France.



THE SUCCESSFUL SANTOS-DUMONT AIR-SHIP.

This is the vessel in which the young Brazilian inventor sailed from St. Cloud to the Eiffel Tower and back again, a total distance of 10 miles in 40 minutes, the most noteworthy achievement in the history of aerial navigation.

It was as a result of this triumph that the directors of the St. Louis World's Fair decided to offer large prizes for achievements in controllable air ships, to be exhibited at the Louisiana Purchase Exposition.

Inventors have been at work on the problems of aerial navigation for a long time, and the experiments, roughly speaking, have been in three directions. The balloon which supports itself and additional weight by the buoyancy of its contents, to be propelled by a motor and directed by a rudder, has been the favorite theory upon which to work. The true flying machine, which without buoyancy of its own should be supported and propelled as birds are, by an actual flapping wing-motion, is the second direction in which inventors have worked, and with less success. The aeroplane has been the third fundamental theory upon which inventors have labored. The kite itself is the most primary of the aeroplanes, supporting itself as it does, not by any natural buoyancy, but entirely by the pressure of the air against its surface. Three noteworthy inventors, Lilienthal, Maxim and Chanute, are best known in this line of experiments. They have worked in the same direction with a considerable degree of success. The idea is that a combination of plane surfaces, properly adjusted and balanced, would enable the navigator to remain in the air by soaring, just as a bird may do with outstretched wings.

The most practical use of balloons thus far has been made in warfare and in military experiments. The idea of using balloons in war is more than 100 years old, the first attempt made to put the project into execution being in France in 1794. Napoleon organized a balloon corps for his second campaign in Egypt, but before it could be employed, the wagons containing the materials were captured by the British. During the siege of Paris in 1870, balloons were used extensively, and news was carried by that means from the beleaguered city to the provinces.

There is a military school of ballooning at Aldershot, where every balloon intended for the service is tested, where those whose business it is to use the balloons are instructed, and where all sorts of experiments are carried on. All the nations of Europe are engaged in attempting to bring the science of aerial navigation to perfection. It is no doubt a serious matter to consider that if ever the science were really made practical, the finest navy afloat could not stop the destruction of a city by a military balloon armed with explosives.

The latest improvement in war balloons comes from Germany, and experiments have been conducted in England with balloons of the same type. They are strange-looking objects, like a huge sausage floating in the air, instead of the familiar shape. Hitherto the wind has been the greatest difficulty to overcome in this science. Even a moderate wind was sufficient to prevent the huge sphere of the familiar type of balloon from rising to a great height. The new invention provides for an airship of great length and comparatively small diameter, floating at an angle of about 45 degrees to the horizon. It rises in the air on a slant somewhat like a kite, and a smaller balloon, towed astern of it, acting like the tail of a kite, assists in keeping the balloon in the desired position and helps to maintain its steadiness. Oscillation is largely obviated, and special advantages for photography are thus afforded. The basket is hung to the rear end, and from it extends a cable which holds the balloon and the telephone wires by which communication is maintained. By such a captive balloon battles may be viewed from a distance, fortifications may be inspected, and other military objects may be attained.

No longer do scientists and mechanical engineers discredit the possibility of a practical flying machine or airship. Such a successful invention will be no more wonderful than other triumphs of genius which the last few years have seen, and it seems a reasonable prospect that we are on the verge of a successful aerial invention.

TRIUMPHS OF PHOTOGRAPHY

Photographs taken from a balloon high in the air, and showing clearly great commercial or landscape scenes, with a camera as large as a small room, are the latest developments of the photographer's art and industry. Views including thousands of men and women, actually recognizable by their friends, can be made when occasion demands. The progress of photography at this time is so rapid that one hesitates to limit its possibilities by any prediction.

Long before books were made, before even paper and printing were invented

PREPARING TO TAKE A GREAT PHOTOGRAPH.
The view of the Chicago Stock Yards, taken from the balloon high in the air, is one of the most noteworthy achievements of photography.

back in the childhood of the race, primitive man recorded the events of his life and the manners and customs of the times by inscriptions carved in the face of the eternal rock. It was before the time of written words or even an alphabet. And so these early historians wrote their works in that most graphic of all manners, by making pictures. It is a self-evident fact that crude as are the drawings in stone that have come down to us through the ages, they give us a far better idea of life as it was than could be possible if instead of pictures they had merely described things in the simple words of a primitive language. Art is the universal language, understood by all, needing no translator for a picture of things as they are.

So it has been through all the ages and so it is to-day, that pictorial representations have been not merely an important adjunct to literature, but in many ways have surpassed it in the popular view. Descriptive matter combined with illustrations, presents subjects with clearness to the inquirer, but if only one can be chosen there are many instances in which the picture would tell the story better than would the text alone.

The first photograph made in England in 1802, or even the first product of the perfected apparatus in 1841, will hardly suggest the same processes that are used now in these most wonderful modern pictures. Within the last fifteen years of the nineteenth century such advances were made as naturally led up to the most conspicuous triumph of all. The old wet plate or collodion process of photography, with its slow exposure, was superseded by the dry plate, rapid in action and convenient to handle. Two dozen dry plates could be

THE LARGEST CAMERA EVER MADE.

handled with more ease than a single one of the old-fashioned kind, and so amateur photography spread until hand cameras became almost as common in the household as stereoscopes used to be. The invention of the transparent film of celluloid, wrapped in black paper and wound on a spool like ribbon, so that it could be placed in the camera by daylight, made it possible to do away with glass plates for photographs, and travelers consequently could provide themselves with material for a thousand pictures, more easily than for two dozen under the old regime.

To-day photography is recognized alike as an industry, a science, and an art. The public demands photographic illustrations for its books and its magazines, remaining no longer contented with imaginative views, skilfully painted, drawn or engraved by a fallible artist. Nature has become the one acceptable illustrator. At the behest of the photographer, by his lenses, his sensitive a cable which holds the balloon and the telephone wires by which communication is maintained. By such a captive balloon battles may be viewed from a distance, fortifications may be inspected, and other military objects may be attained.

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plates, and his paper, the sun itself imprints the image of whatever scene is to be recorded, and gives it to us with the certificate of nature's truth. Such a work as the volume in hand, illustrated as it is by hundreds of photographs gathered from all the world, could not have been produced at all except by the aid of this graphic art. With the best illustrations possible otherwise, it would have cost many times as much as it does, while being in no degree comparable with the work as it now stands. So it is that the industry and art of the photographer, and the science of the inventive genius which has developed the camera, make it possible to bring to every reader a clear perception of the great and interesting things of all the world in such a form.

To-day every land is the scene of the photographer's labors. The explorers who make a dash for the north pole, they who penetrate the jungles of Central Africa, and they who surmount the highest peaks of the Andes, in every instance depend on the camera as a truthful witness of what is found. Great historical occasions, political events, commercial scenes, all are the subject of photography. Books of natural history, formerly illustrated by conventional drawings from stuffed birds and animals, now have photographic representations of the wild creatures of the forest, taken in their own habitat, by patient, wary lovers of nature. Such great institutions as the Chicago Stock Yards, large business offices and factories, immense popular gatherings and the like, many of which are included in this volume, are now the subject of the photographer's skill. Is it not a manifest fact that we would know far more about the life and manners of our ancestors, their homes and their cities even one century ago, if an art thus developed had been at their command, by which they might have left true records in pictorial form? Is it not likewise true that our descendants a hundred years later, by means of such collections of photographs, will have a clearer view of the world as it is to-day than they could have by any other record that we can leave to them?

The great camera with which these larg-

READY FOR A FARM PICTURE.
Showing the great camera on a specially erected tower, with a range of many miles.

THE MODERN CHARIOT RACE.

Photographed on the Grosse Pointe race track near Detroit, when Alexander Winton of Cleveland drove his automobile ten miles in eleven minutes and nine seconds. Mr. Winton is ahead, nearest the fence.

est views are taken, measures eight by four and one-half feet, and one sensitive plate for a single photographic exposure costs $500. For bird's-eye views of cities, farms, industrial and manufacturing plants, railway yards, stock yards, and the like, where no suitable elevation exists, a balloon is used to hoist the camera and the photographer far above the earth while he takes the picture. Farm views of property for sale are used by agents in the finding of buyers, and such views are likewise becoming popular among farmers themselves who take pride in their property. For such a picture, the camera may be mounted high in a treetop. Great business concerns use such photographs to advertise their enterprises, and thus photography in this most striking development of the art, becomes a recognized industry.

THE AUTOMOBILE AND ITS DEVELOPMENT

Automobiles have become so common in the streets of the larger American cities, that except when some novel design makes its first appearance there is no longer any special attention given them as they pass. The bicycle itself became a familiar sight hardly more rapidly than has the automobile, in the very few years since it was put on the market as a practical road machine. Scientists and inventors have been busy perfecting the various power-appliances and running-gear utilized; capitalists have hurried their investments into great manufactories for the construction of self-propelling vehicles, and the public has been prompt to respond to the attractions of the swift and comfortable conveyance as perfected by the energetic business concerns that placed them on the market. The striking rapidity with which these contrivances have come to be used, and the manifest possibilities which they have in their perfected forms, have created a phrase "the Horseless Age," for these years of activity in such inventions.

Ever since the steam engine itself was invented and the locomotive adapted from it, there have been efforts made to build practical self-propelling road machines which would not require a track. Heavy traction engines and steam rollers for road improvement have been quite generally employed, but they have never taken such a form as would make them available as passenger or pleasure vehicles. About 1890 French inventors turned their attention in this direction, and till a few years ago virtually all the progress that had been made was in France. Then American energy and ingenuity likewise became interested, and since then France and the United States have been rivals in the race for improvement in automobiles.

Thanks to the larger leisure class of wealthy men with time and money for experimentation and touring, automobiles have multiplied in France far more rapidly than in this country. In 1899 there were but 1,672 of the "horseless carriages" in France. One year later there were 5,286. In 1901 the number was above 9,000, and the increase still continues with the same rapidity. Of course the uniform excellence of the roads throughout France and most of the other European countries helped to advance the development of the motor carriage. With us, except in limited districts, the country roads are not such as to encourage touring, and the vehicles consequently have been confined to the cities.

The movement for road improvement and the rapid introduction of automobiles should be effective allies for each other. Good roads throughout the country will make the use of the automobile possible where now it is impossible, and the multiplication of such vehicles in villages and on farms will help to stimulate local pride for the improvement of the roads.

Self propelling vehicles, or automobiles, are now built in scores of patterns and are adapted to every sort of use. Light pleasure carriages, omnibuses, delivery wagons and heavy drays alike are seen on the streets of cities. In Paris the fire department uses an electric automobile, and in other cities the chiefs employ light vehicles for their own use in going to fires. The mail is gathered for the postoffices of several of the larger cities by large wagons equipped with motors. Ambulance and ammunition wagons have been equipped with motors by the French military authorities, and railway hand cars driven by light gasoline engines are in use.

It has been difficult for designers to completely abandon the forms of vehicles that have developed under former conditions. One great trouble with the motor carriage, in the judgment of most critics, is that it does not get far enough away from its predecessors, and makes too evident the fact that it is really a "horseless carriage." Of late there is a tendency to more graceful designs, smaller wheels and less gearing.

For pleasure uses and for practical busi-

READY FOR A WINTER SPIN THROUGH THE COUNTRY.

ness it is necessary to provide a vehicle as light as possible for the necessary strength required. A cheap and reliable motive power, without noise and without odor, is likewise a requisite. Five or six different power mechanisms are used, of which electricity, steam and gasoline are the most popular. Compressed air and liquid air are also the object of experiments, with varying degree of success.

Henri Fournier, who is recognized as, perhaps, the leading automobilist of the world, prefers a hydro-carbon engine, and all his own road machines are thus fitted. With such a motor he rode from Paris to Bordeaux, a distance of 348 miles, eighteen miles of it through cities, in six hours, forty-four minutes and forty-four seconds. The 330 miles along open roads he covered at an average of fifty-three miles an hour, and for some of the way he was traveling at seventy miles an hour. The fastest train in Europe requires an hour longer to make the same trip. In a race from Paris to Berlin, 744 miles, he covered the distance in sixteen hours and six minutes. No such American speed records for such distances have been made, but for short runs some astonishing achievements are recorded. On November 16, 1901, at Prospect Park, Brooklyn, Fournier himself made a mile in fifty-one and four-fifths seconds, which is the world's record for a straight boulevard run. Three weeks before, all American track records up to ten miles were broken by Alexander Winton of Cleveland, at Detroit. His fastest mile was made in one minute, six and two-fifths seconds, while he covered ten miles in eleven minutes and nine seconds.

But the automobile is not merely a conveyance for speed and pleasure. In 1901, a Chicago enthusiast made a cross-country tour of 2,600 miles over the typical American country roads, without once requiring the attention of an expert mechanic for his motor or his vehicle. The Sierra Nevada Mountains were crossed during the month of May, 1901, at a season when the snow-covered mountain trails were not considered fit for horse traffic. Pike's Peak, too, has been surmounted by at least one automobile. The hill-climbing capacity of the perfected machine is something astonishing. For city use the electric vehicle has been favored, because of its simplicity, cleanliness and silence. Equipped with storage batteries as it is, it must be recharged frequently, however, and consequently is not yet available for use throughout the country. As storage batteries are steadily improving and electric power plants are multiplying all over the country, this form of machine is certain to become even more available and popular. With the same battery the current not only operates the motor for the wheel, but also lights the lamps and rings the alarm gong. The machines operated by gasoline, either through a modification of the ordinary gasoline engine or by steam heated from a gasoline flame, are independent of the cities and charging stations, for that volatile liquid can be obtained for a few cents a gallon wherever one goes.

The expense of machines has been great enough to forbid their general use, ranging as they do all the way from $600 to $4,000. But as the machines gain in simplicity they reduce in cost. Already devices have been planned by which any vehicle may be temporarily converted into an automobile. A front axle carries a motor between its two wheels, and this axle may be attached to any carriage or wagon as a substitute for its own equipment. With this appliance perfected, the farmer, for instance, with one of them, could change it from surrey or spring wagon to haycart or lumber wagon, and have as many automobiles at will as he had vehicles. It may be long before the phrase "horseless age" becomes even approximately true, but beyond question the applications of electricity and other motive power to a multitude of the uses where horses have been employed will work a great change within the next few years.

THE ROENTGEN OR "X" RAYS

It is barely five years since the announcement was made through the press that a discovery had been made by which pictures can be taken showing the interior of the human body. The announcement was greeted with widespread incredulity at the time, but within the five years that have elapsed, the public has become entirely familiar with the pictures and the phenomena involved in their production, and the stage of wonderment has almost passed.

The discoverer was Professor Roentgen of Wurzburg University, Germany, whose experiments, carried on through a considerable period, had reached this triumphant conclusion. The rays utilized for this purpose are developed by the Crookes tube, the invention of a famous English chemist. As the peculiar electrical rays thus generated and identified by Professor Roentgen were hitherto unknown, he used to designate them the algebraic term of X, meaning an

A ROENTGEN RAY PHOTOGRAPH OF A BROKEN ARM.
A fracture of the ulna, with dislocation of the radius.

unknown quantity. His fellow scientists throughout the world, recognizing his noteworthy contribution to science, promptly named them the Roentgen rays, and it is by this name that they are properly known, although the popular usage still applies the characterization of X rays.

Until the discovery of these rays and the application of them to practical use, it was impossible for surgeons to be absolutely sure of the location of bodily injuries or the condition they would find within the body, until after an operation. By their means, however, it is now possible for the surgeon to examine fractures or the condition of the lungs, to trace the location of a bullet, or to make such other examination of internal ailments as is necessary. It has been possible to use the rays so that a bullet lodged against a man's heart was photographed before removal and was then taken out and the recovery of the man assured. Foreign growths in the lungs, pins and needles which have penetrated into the body, broken ribs, swallowed buttons, and all such things can be examined with care prior to the operation, so that the necessary surgery can be performed with the least danger to the patient. The use of these rays is not objectionable nor painful to the patient, except when experiments are made repeatedly upon the same person, when sometimes the weakening of certain vital organs has resulted. It is a recognized discovery in surgery that is utilized in all the principal hospitals of the world as a measure of the greatest value.

Brain specialists have hailed with joy the X ray as a medium for learning whether clots of blood are pressing on certain parts of the brain, thereby causing insanity or inaction of some of the faculties. One well-known lawyer in a fight with burglars received a severe blow on the head which rendered him insane at times. By means of a skiagraph or X ray picture, a shadow was seen that indicated a pressure on one of the brain convolutions. A cleft was made in the skull, the pressure removed, small bone particles placed over the cleft and the skin replaced. Apparently the lawyer's reason was restored.

In stomach diseases it has been very difficult to locate enlargements or to indicate conditions of the membranes. Recently saturated chemical solutions impervious to the X rays have been poured into the stomach, and skiagraphs taken which resulted in remarkable discoveries. Other uses of these rays are constantly coming before the public. Some time ago a Chicagoan suffered great agony from what seemed to be an abscess behind the base of the nose. By means of the Roentgen rays a skiagraph showed that the sufferer had in the cavity at the back of his nose a small sac containing thirty-two miniature teeth. An operation was performed successfully, but for which the patient might have died. It is hinted that mental conditions are expected to be discovered by the aid of this remarkable light. Certainly nearly every other malady has been treated with a measure of success. The heart can be seen beating in one's breast, and enlargements or diseases can be promptly treated. Consumption of the lungs is discernible before it reaches its last stages, and ruptures, fractures and the presence of foreign substances can at once be noted.

Apart from medical use the X ray was recently employed to explore the interior of a mummy casket that had never been opened since the time that some old Egyptian Pharaoh had been wrapped in his burial clothes. Also mummified animals, so dried up that the family to which they belonged could not be ascertained, were easily classified after skiagraphs had been made of their bones and skulls.

HATPIN IN THE STOMACH OF A THREE-YEAR-OLD CHILD.

The hatpin shows with the head downward in the stomach. It was removed by operation. The hatpin was six and one-half inches long.

Some noteworthy experiments have been made which display the remarkable scope of the application of the Roentgen rays. Coins inside of pocketbooks, the lead in a pencil, the kernel of walnuts within the shells, and spectacles within their cases, have been photographed. Fish, mice, and frogs have been photographed, showing the skeletons.

The ordinary camera may be used in photographing by the Roentgen rays. A sensitive plate is laid in a box, face downward, over the subject to be photographed. The Crookes tube which develops the ray is placed under the table or stretcher on which the subject is resting and the light passes through the patient's body and prints a shadow picture on the plate. In the original experiments, there was great danger of burning the patient by the electrical current developed, but this has been obviated by more improved appliances. The electrical current itself is produced by the static machine and this current passes through the Crookes tube and illuminates whatever part of the body it is desired to examine.

It is apparent that the possible uses of such a discovery are manifold, and its value is impossible to be measured. With the whole human body thus subject to careful examination, it is a guard against unnecessary or misdirected surgery. Thus is one more scientific discovery added to the list of those of noteworthy importance, not merely in the limited circles of special students, but to the whole world.

There can be no monopoly in brains, and no monopoly of the benefits which come to the world from such great scientific achievements. We all share the advantages of intellectual progress, whatever its form.

MODERN DEVELOPMENTS OF ELECTRICITY

Electricity is a force of nature which is utilized in almost every department of industrial activity to-day. Its applications are so varied in the transmission of power, light and intelligence, that it is no longer possible to ignore it in the development of any great mechanical and industrial enterprise or even in the common activities of life. It is not necessary to turn to such recent applications of electricity as wireless telegraphy, Roentgen rays and the like, to be impressed by its importance.

It is the electric telegraph which trans-

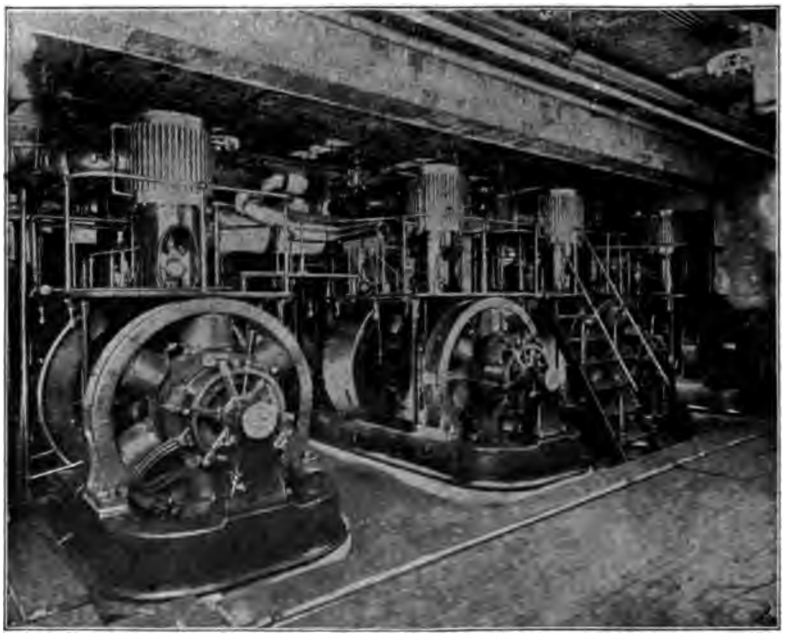
Thos A Edison

mits our messages from town to town, the world over, in the twinkling of an eye. It is the telephone, perfected by careful experimentation, that enables us to communicate by ordinary conversation between persons not only within the same town, but a thousand miles apart. It is the electric trolley car which has speedily supplanted almost all other systems of street railway transportation. The European cities are following those of America in this manner, and trolley-lines are being constructed all over the world as fast as the multitude of electrical supply and manufacturing companies can produce the materials. It is within comparatively recent years that we had the first introduction of the electric light, both arc and incandescent, and yet now it is almost universally used in cities for all public purposes, and is rapidly extending into the smaller towns. Pictures are sent by telegraph so that an artist in one city may transmit them instantly to another city, in complete reproduction.

Experiments have shown that plants may be grown under the electric light almost as successfully as under the sunlight. It is in St. Petersburg, thatthe most important experiments in this direction have been made. Owing to the long winters in the far north, during which the daylight is brief, in conservatories it was found difficult to produce thrifty plants and flowers at this season. It was this that stimulated the experiments with electricity, and it was found that the artificial light completely supplemented the light of the sun. In addition to this, electrical currents have been used directly to stimulate plant growing with good results.

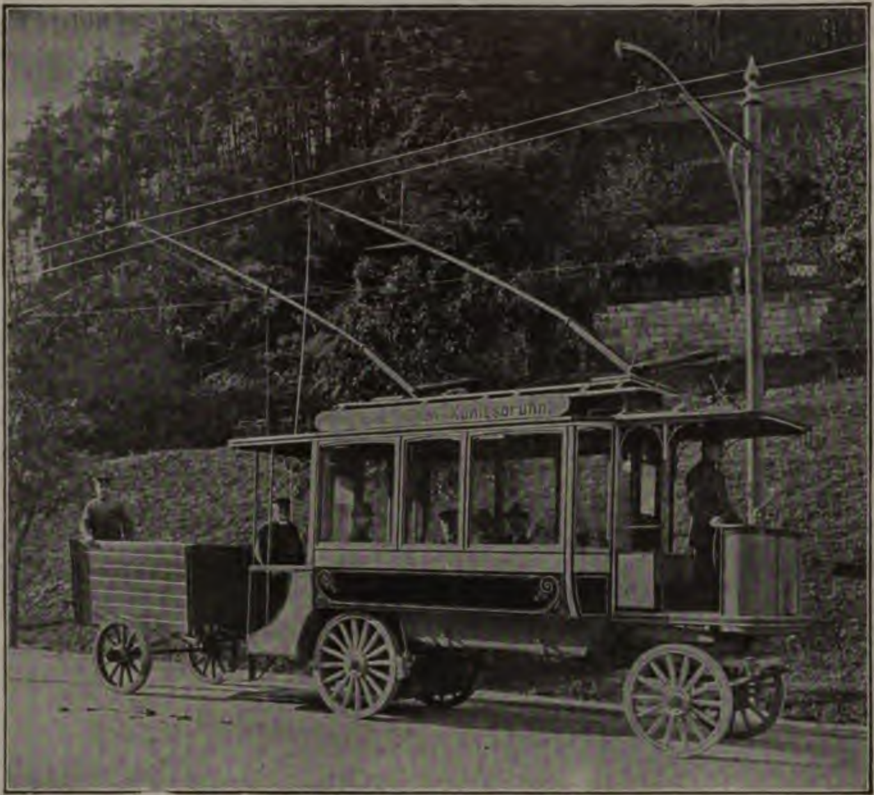
ELECTRICAL ILLUMINATION OF A CITY STREET.

In telegraphy various improvements have been made, among others being one invention by which the typewriter and the telegraph instrument are combined. The wires are attached to a sort of electrical typewriter, which, upon being operated, sets in motion a similar machine at the other end. The operator transmitting the message merely writes it by playing on the keys of the machine before him, and it is recorded at the receiving station, wherever that may be. By perfecting this system the transmission of newspaper correspondence will be greatly facilitated, for the correspondent himself may dispatch his account of events, without the aid of a telegraph operator. Another recent invention in telegraphy is a method of perforating strips of paper with a machine similar to a typewriter, and then placing these strips in a sending device which transmits the messages at a rate of 10,000 words an hour or even more. Such a machine makes it unnecessary to duplicate telegraph wires, by the additional speed attained. As many strips as can be prepared by a number of men can be sent over a single wire in a few minutes.



DYNAMOS OF AN ELECTRIC LIGHT PLANT.

The developments of trolley lines are numerous. In addition to the well-known street railway systems operated by overhead trolleys, there are other modifications of this method of power-transmission which have not yet come into general use. The underground trolley, favored because it obviates the necessity of using the unsightly poles and dangerous wires of the overhead system, is utilized in a number of progressive cities, and beyond question will come into more general use. The modern elevated railways of Chicago and other cities are operated by what is known as the third-rail system, which is in effect a modification of the underneath trolley. The underground railways of New York, Boston, London and several European cities, which have been extending very rapidly within the last few years, are all operated by electricity and the tunnels themselves are brilliantly lighted by the same force. Canal boats are operated by trolley on several European canals, and the system is under consideration for introduction in some American canals. Trolley cars are operated on the streets of some European cities without tracks and large quantities of freight are transported in this manner.



TRACKLESS TROLLEY CAR.

Electricity has a peculiar convenience of transmission from the fact that its power can be conducted for long distances over wires with comparatively slight loss. Dynamos operated by waterfalls and rapids have been installed in various places with great success. The most noteworthy of these undertakings is at Niagara Falls. The great cataract now generates the electric power for a large number of factories in the vicinity, for the street railways and electric lights of Buffalo, and for various other industrial purposes. The total power now developed and utilized by the works at

SWITCH ROOM OF NIAGARA FALLS POWER HOUSE.

Niagara is about 50,000 horse-power. The flow of water over the falls is 275,000 cubic feet a second, or 500,000 tons per minute. A canal has been cut on the American side, taking water from the river above the falls, and leading it to a great pit into which it plunges, operating a series of turbine engines which connect with the dynamos. It is estimated that works could be constructed sufficient to develop 7,500,000 horse-power from the falls, so that the 50,000 horse-power now utilized may be many times multiplied. The result of this enterprise has been the rapid growth of the city of Niagara Falls and the multiplication of large factories and industries there.

At various other cities, particularly in the west, waterfalls have been used for the development of electrical power, and many street railways and electric lighting plants are operated by currents transmitted for many miles from the source of the power.

The applications of electrical power are so numerous that they cannot even be catalogued. Great factory machinery is run by electricity; bridges are turned or hoisted by the invisible current; elevators and automobiles utilize the same power. In

A TROLLEY-CAR SNOW-PLOW ON A MONTREAL STREET RAILWAY.

fact the mere listing of the uses of electricity, industrial, scientific and otherwise, would make a chapter, as truly a chapter of wonders as this modern industrial age and its allies, science and invention, can offer.

E. E. Rines, an Indianapolis electrician, has invented an incandescent bulb by which the degrees of illumination may be varied. He has been working on it for years, and finally completed a lamp that is a success.

His invention is especially designed for dwellings, hotels and hospitals. He has taken an ordinary sixteen-candle-power globe and arranged it so that it may be turned to use eight, four, or two, candle-power. This is done by using connections that are different from the old style, and two filaments—the little wires that curve around the inside of the bulb.

By turning the globe a little the light may be reduced from sixteen to eight candle power. A little farther reduces it to four, and still farther to two. Then, if it is desired to have sixteen power again, one just turns it back and the light burns bright. The advantages of this system in a sick-room will be appreciated by the hospital authorities.

Rines is a graduate of Cooper Institute and Columbia College and worked twelve years with Thomas A. Edison.

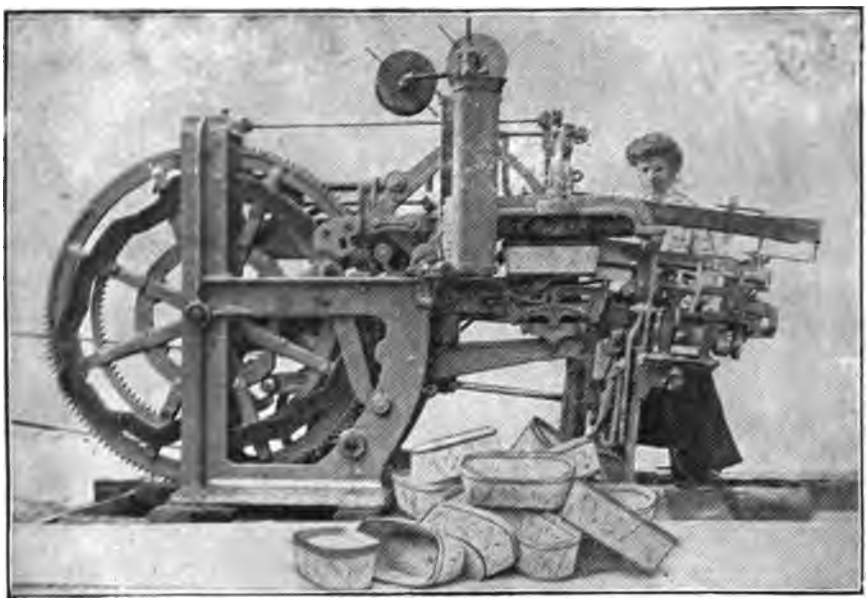
"I have had practical as well as technical tests made of this lamp," he said. "It consumes three and one-half watts per candle power per hour, which is the same as any high-grade, high-efficiency standard lamp. When one filament is burning full eight candle-power, it consumes twenty-eight watts per hour. When burning two candle-power two filaments dark, red or in series, it consumes seven watts an hour for a night lamp. The two candle-power will save forty-nine watts an hour. On ordinary lighting an eight candle-power lamp, which is generally used, will save twenty-eight watts an hour. When burning sixteen candle-power, the two filaments in multiple, this lamp will save over the average lamp one-fourth to two and one-half watts an hour. Its life will equal those of any three standard lamps. In consequence of current this lamp will save 13,650 watts in 500 hours, the life of an ordinary lamp"

BASKET MAKING BY MACHINERY

Two billion baskets of fruit are marketed annually in the United States and the demand for such baskets is increasing at the rate of 150,000,000 per year. The peaches and the berries must be shipped into the cities with the utmost rapidity and regularity, in order to take advantage of the best market conditions, and obtain the best prices for the products. So it is that one of the most important departments in the freight service of American railways is that which gives its attention to these shipments. So it is that during the summer season, to offer a single example, the fleet of vessels plying across Lake Michigan between Chicago and the ports of the State of Michigan, are filled to the limit of their capacity with luscious cargoes of peaches and berries.

A recently perfected invention in the interest of the fruit grower is recognized as of the highest importance in this enormous traffic. These 2,000,000,000 baskets have been made by hand, and, of course, although the price has seemed low, there has been an immense waste of labor in this process. Machines have now been invented and are in practical operation, by which these baskets are made automatically, doing away with hand work, and enabling one girl and one machine to do the work of twelve men. The names of the two inventors who have shared in this noteworthy achievement have given to the invention the name of the Mergenthaler-Horton Basket Machine. The former was already famous as the inventor of the type-setting machine, which has revolutionized the mechanical departments of newspaper offices. The new invention is considered quite as great a triumph. Hand labor in such affairs cannot hope to compete with the production of perfect machines. Already the baskets thus automatically produced have proved so successful that commission merchants urge that their shippers pack in such baskets, because they are stronger and more shapely and satisfactory.

The various patterns of machines that are made, are adapted to turn out baskets of various sizes and shapes according to the demand of the trade. A single machine will turn out, day after day, over 4,000 complete grape baskets. A single berry basket machine will turn out 12,000 complete quart berry baskets a day or twenty baskets a minute. The machines work with almost human ingenuity, and with a precision characteristic of the mechanical exactness of the mind of a great inventor. It is difficult to give any idea of the impression this machine creates upon the mind of one who observes the work for the first time. The endless stream of baskets coming from the machine at the rate of twenty a minute, absolutely complete and perfect in every respect, with the raw material in the shape of long strips of wood being fed into the opposite side, cannot be satisfactorily shown by any photograph. In the three seconds necessary to turn out such a complete basket, the sides and the bottom are formed of crossed sheets of wood of appropriate shape, bent by means of a form and a die, secured at their edges by wrapped bands lying inside and outside the edges, and strongly nailed by staples cut into proper lengths from a roll of wire, bent and driven firmly into the wood. The grape baskets are made on similar principles.



GRAPE BASKET MACHINE IN OPERATION.

LIQUID AIR.

Liquid air seems almost a contradiction in terms at first thought and yet scientists are able to liquefy not only air but many other gases, while they can also turn solids into liquid, and the resulting liquid into gases. It is all a matter of temperature and pressure. Charles E. Tripler, a scientist of New York City, is the one who made liquid air familiarly known, cheapened its production and applied it to practical commercial purposes. He was not, however, the pioneer in the experiments. Scientists had long observed that to compress a gas into a reduced volume, raised its temperature greatly. The heat thus resulting was believed to be generated by the pressure applied, but experiments soon proved it was not caused by the actual increase of heat of the whole body, but rather by the concentration of the heat of the entire mass into the smaller space.

Experiments next showed that if this gas under pressure was cooled, and then allowed to expand to its former volume, it would fall greatly in temperature, and in practice a drop of 200 degrees was readily obtained. Scientists made little headway in the effort to liquefy air, until 1877, when a French experimenter named Raoul Pictet submitted oxygen gas to a great pressure, combined with intense cold, and produced a few drops of clear liquid that soon evaporated into the air after a few moments of violent bubbling. Fifteen years later, in 1892, there was a like success with nitrogen, the other constituent of air. About the same time Professor Dewar of England performed the same experiments, and then succeeded in producing a small quantity of liquid air, or rather a sort of slush of air, water and ice. Professor Dewar's experiments aroused the utmost interest among scientists, but the cost of the apparatus and processes, which amounted to $3,000 for this first ounce of liquid air, limited it to laboratory experimentation.

It was Professor Tripler who devised the means by which this wonderful product could be made with ease, at a cost of not more than twenty cents a gallon. His process comes as near being a practical form of the chimerical perpetual motion as can be conceived, for he utilized power generated by the liquid air itself to produce more liquid air, and as the production from a given quantity is in each instance a larger quantity, there is the constant increase of power at command. After exhaustive investigation of various ice-making and refrigerating plants, such as are used in packing houses and breweries, he devised the apparatus now in use.

A typical apparatus includes a power plant operating an air compressor, and a barrel shaped tank about fifteen feet high, penetrated by a multitude of small pipes and valves, protected by felt and canvas to keep out the heat. It is arranged so that the expanding air, which constantly grows cooler, passes about the pipes containing the working material. Air is placed under a pressure of 2,500 pounds to the square inch, and cooled to about fifty degrees by being passed in pipes through cold running water. Next it is conveyed to the receiver through two sets of pipes, one containing the air to be liquefied, the other the air that does the work of liquefying, both under the same heavy pressure. By opening a tap in the receiver, the air from the latter pipe rushes up and around all the pipes in the barrel-like space, expanding, reducing the pressure, taking up the heat wherever any can be found, growing warmer, and gradually rising to the top of the space.

During this process it is cooled, the air confined in the pipes and now gradually returning to the compressor, is again brought under pressure and cooled, only to be released once more in the receiver to absorb more heat from the confined air in the pipes. This process is so rapid and so effective, as the temperature of the air under treatment goes down in jumps of 100 degrees every time it is treated to this chilling process, that it takes only fifteen minutes to produce the desired result. At the end of that time the faucet at the bottom may be opened, and the liquid air at a temperature of 312 degrees below zero begins to flow from the pipes.

In order to preserve the product thus yielded, various devices have been prepared. Liquid air is of such an expanding nature that if confined it would explode, so it is carried sometimes in a bulb of glass, surrounded by an outer vessel of glass, the two having a vacuum between them and joined in a common neck at the top. The vacuum delays the passage of heat, so that the evaporation of the liquid in the inner tube is reduced to a minimum. The cold, heavy mist that evaporates from the surface of the liquid and remains in the mouth of the bulb, helps to shield the rest of the contents to some extent. A similar vessel for commercial uses and the shipment of large quantities of the liquid, has been made from heavy tin, covered with felt and canvas. In a shipment of nine hours, air thus packed loses less than one-third of its bulk.

The commercial possibilities of this peculiar product are hardly yet realized, although it is clearly understood that as a source of concentrated power it has great value. It is eleven and one-half times as powerful as compressed air, and yet it may be carried in a pasteboard box, while the heaviest steel tanks would be required to control as much energy in compressed air. Experiments are in progress in the laboratory of Mr. Tripler all the time, looking toward the applications of liquid air for motive power. Airships are seeking something that combines great power with lightness; submarine navigators want an economical motive power and air for the crews to breath; deep sea divers hope that some service may be rendered to their perilous profession by the use of casks of the liquid adapted to their apparatus, and automobiles have been adapted to this power. In mining, in the production of incandescent electric light bulbs, in surgery and in the production of explosives, the same peculiar substance has its manifest use.

The degree of cold which this temperature indicates is hard to realize. Mr. Tripler has appeared in public and performed many picturesque and striking experiments which indicate this. A rose may be frozen in its full form, or an egg be made so solid that when broken it will scatter like a powder. The surface of a frozen potato is as hard as stone and beautiful as ivory. Frozen butter may be pounded in a mortar until it is as fine as flour, and raw beef steak becomes pale and then breaks like petrified wood. We have generally considered mercury and alcohol as difficult to freeze, but when they meet this powerful liquid, mercury becomes hard as a rock and alcohol a white, stringy substance like molasses candy. Steel in bars may be readily reduced to flame by dipping it in a glass of this air and lighting it.

LUXFER PRISMS AS LIGHT TRANSMITTERS

While some scientists have been busy with new inventions for the production of improved light from electricity and gas, others have given their attention to the more effective use of the light which is free to all, that of the sun, which is the ultimate source of all light. The Luxfer prism, invented by a Canadian investigator of the phenomena of light, J. G. Pennycuick, is admittedly one of the most noteworthy of contributions to practical optics.

HOW THE PRISM ACTS.
Showing ray of light from above, deflected to a horizontal course as it passes through the glass.

Luxfer prisms are sheets of crystal glass having a smooth outer surface, and an inner surface divided into a series of small, accurately formed prisms. They can be united into plates of any size, to fit any window sash. The rays of light from without, that strike the smooth surface, penetrate it as they do any other glass. The prisms on the opposite surface, however, are set at such an angle that the light passing through them is refracted to a horizontal direction, and thus illuminates the room much farther from the window than is the case with ordinary, plane-surfaced glass. The dark corners are lighted, the gas and electric light bills are reduced, and all this without a meter to continually register the saving and bring in a charge for it.

These prisms and their modified forms are applied to use in a multitude of ways. Large stores have them placed in the transom frames above the front windows, so that the rear of the long rooms may receive ample light. The same prisms placed like an awning in front of windows in a narrow, shaded street, gather the scanty light

LUXFER PRISMS IN USE.
Illumination in a basement salesroom by means of prisms in the sidewalk.

from above and deflect it into the building so equipped. Sidewalks made of Luxfer prisms receive the direct light from the sky on the upper face, and turn or refract it into the basement of the building adjoining. It is said that more than five thousand prominent buildings throughout the United States installed Luxfer prisms within the first five years of their manufacture. This is noteworthy evidence of the fact that new inventions that are of genuine value are sure to find welcome.

ON THE AUDITORIUM TOWER—HOME OF THE WEATHER BUREAU IN CHICAGO.

Here, 320 feet above the ground, the observations are made which help to forecast the weather for the Great Lakes region. The small tower with the encircling balcony is the signal service office, and the instruments are on the roof.

THE WEATHER BUREAU AND ITS WORK

Before the invention of the electric telegraph for the prompt communication necessary between various parts of the world, and the numerous special instruments devised by scientists for recording atmospheric conditions, people depended upon the opinions of keen local observers, whose experience had taught them the significance of various visible signs. All sorts of traditions and predictions that had come down from the past were heeded. The origin of scientific weather study is of comparatively recent date. Even now the value of it is not fully understood. The well-founded doubts and jests based upon the superseded method of predictions still remain. People do not realize the completeness of the organization of the Weather Bureau and the real scientific accuracy of its work. A single error in a forecast becomes more conspicuous than a score of accurate predictions, and the result is that the weather man is still not fully appreciated.

MEDICINE HAT, ON THE SASKATCHEWAN RIVER.
From the great plains of the Canadian northwest come the blizzards of mid-winter.

The Weather Bureau of the United States Department of Agriculture publishes daily more than 100,000 weather bulletins, not counting the forecasts in the newspapers. Most of these bulletins are in the form of postal-cards, printed by postmasters from telegraphic reports, and sent by them to outlying towns for display at suitable points. There is also an elaborate system of redistribution, by means of telephones and railroads from established centers, so that there are comparatively few accessible places which do not now receive daily weather forecasts, even a very short time after the observers have completed their work. The old system of conveying information about the weather, by means of flag displays, is also in general use.

It is a wonderful picture of atmospheric conditions that is presented twice daily to the trained eye of the weather forecaster. It embraces an area extending from the Atlantic to the Pacific, from the north coast of South America northward to the uttermost confines of Canadian habitation. America's cold waves, hot waves and storms are shown wherever present in this broad area. Their development since last reported is noted, and from the knowledge thus gained their future course and intensity is quite successfully forecast. Every twelve hours the kaleidoscope changes, and a new graphic picture of weather conditions is shown. Nowhere else in the world can meteorologists find such an opportunity to study storms and atmospheric changes.

In our Atlantic and Gulf ports there are floating over $30,000,000 worth of craft on any day of the year. And at every port, whether on the Atlantic, on the Pacific or on the Lakes, there is either a full meteorological observatory or a storm-warning display man, who attends to the lighting of the danger lights at night, to the display of the danger flags by day, and to the distribution of storm-warning messages among vessel masters. While the daily predictions of rain or snow by which the public measures the value of the weather service are subject to a considerable element of error, namely, about one failure in five predictions, the marine warnings of the service have been so well made that in over six years no protracted storm has reached any point of the United States without warning being displayed well in advance. As a result of these warnings the loss of life and property has been reduced to a minimum.

FORECASTING ROOM, CHICAGO STATION OF THE WEATHER BUREAU.

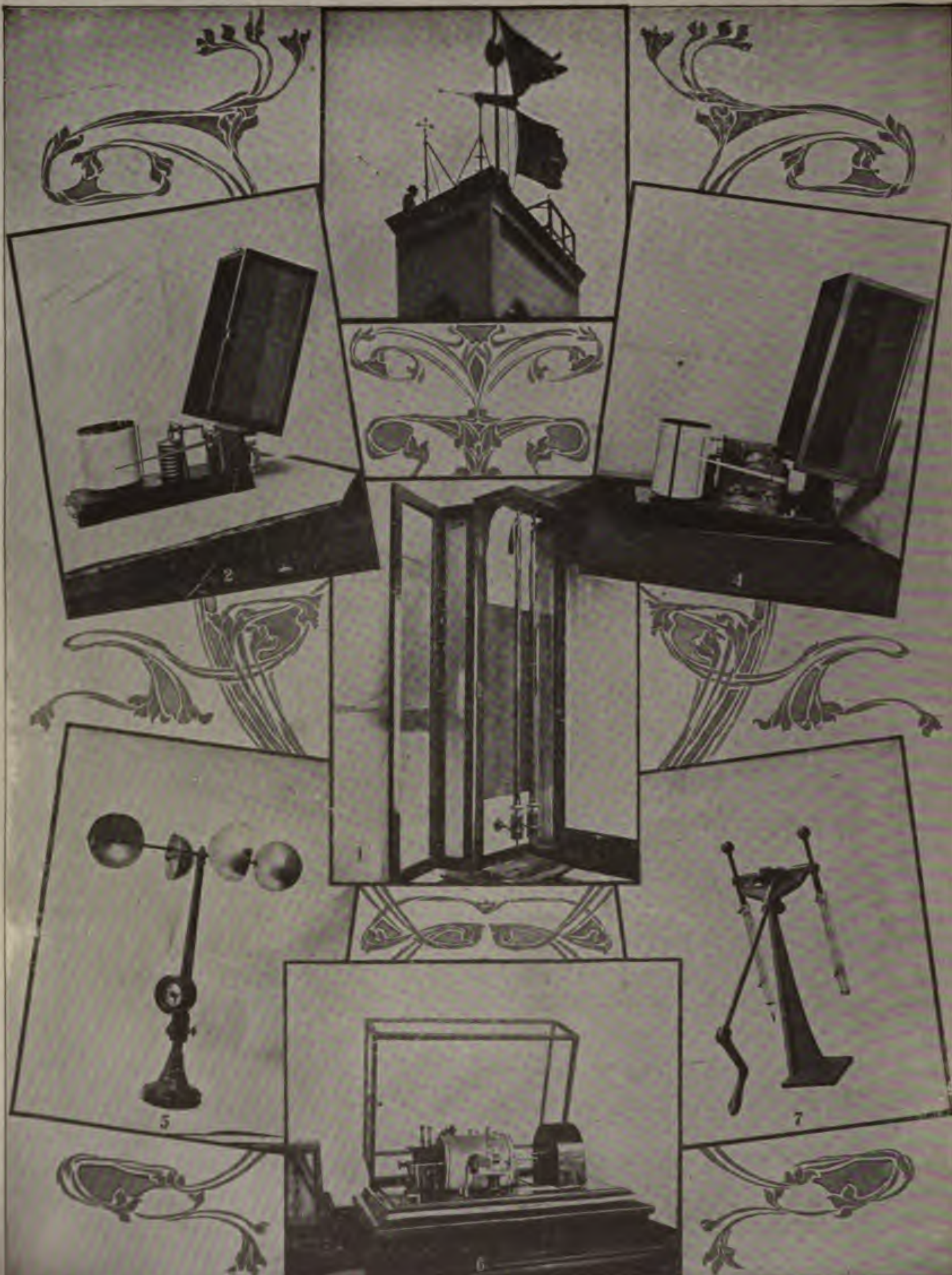
The shipping of the Atlantic seaboard is protected with greater certainty through these warnings than that of any other part of the American coast for the reason that practically all of the storms, except those from the Gulf, which reach the Atlantic coast, originate in the Mississippi Valley. The meteorological data of the Mississippi Valley storms, covering the entire period of the service of the Weather Bureau, shows that these storms reach the Atlantic coast in about twenty-four hours from the beginning of the eastward movement. It is only necessary, therefore, for the weather observers to note the origin of the Mississippi Valley storm and the beginning of its eastward movement, in order to predict accurately the time of its arrival on the Atlantic coast and give warning to shipping.

It is a notable example of the utility of the American weather service, extended into the West Indies, that the great Galveston hurricane of 1900 was detected on September 1 at the time of its inception in the ocean south of Porto Rico, and that the reports were so complete that at no time did the observers lose track of the storm. Such full information was given as it progressed northward, that notwithstanding the extensive commerce of the Gulf of Mexico, little or no loss of life or property occurred upon the open waters of the Gulf. The destruction of life at Galveston was much less than it would have been without the warning that had been given.

When a marked cold wave develops, warnings are given so far in advance that farmers and shippers are able to save property of enormous value by protecting it from frosts. There is one instance recorded in the Weather Bureau showing from definite information that more than $3,400,000 worth of property was saved by the advance warning in reference to a single cold wave. The fruit interests of California derive great benefit from rain warnings. On account of the peculiar topography of that region, these warnings are made with a high degree of accuracy, but a few hours before the coming of the rain, yet far enough in advance to enable the owners of vineyards, most of which are connected by telephone, to gather and stack their trays and thus save the drying raisins from destruction. In the cranberry marshes of Wisconsin the flood gates are regulated by the frost warnings of the Bureau, and where formerly a profitable crop was secured only once in several years, it is now the rare exception that damage occurs. Growers of sugar-cane in Louisiana, the truck gardeners from Virginia to the Gulf, and the orange growers of Florida, time their operations by the frost warnings of the Bureau. From the estimates of these industries it is believed that the amount annually saved to them is far greater than that expended for the support of the entire department.

The flood warning service in operation along large rivers is another valuable feature. It is now possible to foretell three to five days in advance the height of the river at a given point within a few inches. The danger line at every city has been accurately determined, so that when a flood is likely to exceed this limit, residents of low districts and merchants having goods stored in cellars are notified to move their property out of reach of the rising waters. An illustration of the efficiency of this system was shown during the great floods of 1897. Throughout nearly the whole area that was submerged, the warning bulletins preceded the flow by several days, and the statisticians of the government estimate that $15,000,000 worth of live stock and movable property was removed to high ground as the result of the forewarnings. Measurements of snowfall in high mountain ranges of the west have given the Bureau information by which very accurate estimates may be made as to the supplies of water from this source, to be expected during the growing season. In this way the weather service has been brought into close contact with those interested in irrigation, and has become a valuable aid to them.

The instruments used in a fully-equipped signal station of the Weather Bureau are most ingenious and perfect in their applications. The ordinary thermometer and barometer, with which most people are familiar, are but rudimentary in the processes of forecasting the weather. Nevertheless they are prime requisites. The barometer registers the changing pres-



INSTRUMENTS AND EQUIPMENT OF A WEATHER BUREAU STATION.

1. Barometer; 2. Barograph; 3. Signal tower showing flags, anemometer, anemoscope and time ball; 4. Telethermograph; 5. Anemometer; 6. Triple register; 7. Hygrometer.

sure of the atmosphere. The barograph is an improved barometer, which keeps perpetual record, automatically, of the atmospheric pressure. The telethermometer combines the functions of the thermometer and the telegraph. It registers automatically, inside the signal office, what the temperature is outside, communicating from the thermometer without by an electric current over a wire. The anemometer registers the velocity of the wind. It is a perfectly balanced windmill on a small scale, connected with a dial. The anemoscope is better known in familiar language as a weather vane, for it merely points the exact direction of the wind. The hygrometer measures the humidity of the atmosphere, and thus helps to forecast rains. Then there is a triple register of great value, which records the conditions as to wind, rain and sunshine. All such instruments are gradually being brought to a higher degree of perfection, as increased attention is being given to meteorology.

It was about one hundred years after the invention of the barometer, namely in 1747, that Benjamin Franklin divined that certain storms had a rotary motion, and that they progressed in a northeasterly direction. A hundred years later other scientists gathered data and completely established the truth of that which Franklin had dimly outlined. So it was that Americans were the pioneers in discovering the rotary and progressive character of storms, and in demonstrating the practicability of weather service. This country has always kept in the lead among practical meteorologists, largely because of its area, which renders it possible to construct such a broad picture of air conditions as is necessary in the making of the most useful forecasts. It would require an international service in Europe to equal ours in the extent of area covered, and in practical value. Australia, with an area equal to that of the United States, and well-defined conditions, has followed our example with a highly organized, effective service.

In 1870 Congress established the Weather Bureau under the War Department, and it was administered under the direction of the military branch of the government for some eighteen years, until it was transferred to the Department of Agriculture. Under the new regime its value has multiplied many times and the expenditure of the $1,000,000 annually which the service requires has become of slight consequence in comparison with the immense benefits it produces.

MOVING PICTURES AND HOW THEY ARE MADE

The moving-picture machine, under its various names, has become comparatively familiar since the World's Columbian Exposition at Chicago in 1893, when it was first shown in its practical form. Familiarity, however, does not decrease the wonderful qualities of the invention, which is of the utmost importance in many ways. Cinematograph, Biograph or whatever it may be called, the invention is a development of Edison's Kinetoscope, another of the array of marvelous inventions which the "wizard of Menlo Park" has given to the world.

Many familiar experiments and tricks are based upon what is known in the science of optics as persistence of vision. This is a quality by which we retain upon the retina of the eye the image of what we have seen, for a brief period after the light has been cut off or we have shut our eyes. A rapidly whirling wheel does not conceal an object on the other side of it from our view, while the spokes of the wheel in turn are actually intervening between it and the eye. The same faculty of the eye is utilized in viewing motion pictures.

A toy invented many years ago, called the zoetrope, was the forerunner of the more important moving-picture machines. It is a cylindrical box about four inches high and eight inches in diameter, arranged to turn on a pivot in the bottom, the top being removed. On the inner circumference of the box are arranged a succession of pictures, each one in a stage of motion a little farther advanced than the one before it. Through the circumference of the box a series of slits penetrates. The observer, holding the box by the pivot and twirling it quickly, looks intently through the slits as they pass his eye in haste, and sees the figures within apparently moving forward rapidly, something after the fashion of real life, although perhaps greatly distorted.

The series of experiments which followed the zoetrope all utilized the same principle found in the most perfect machines, that is to say the rapid passing of a strip of pictures differing but slightly, behind the lens of a lantern, having a shutter which cut off the light for a short interval as a new picture was moving into place, and again opened to allow the passage of light as the picture paused an instant before the lens. Not until the modern development of instantaneous photography, the dry plate and the transparent film, could such pictures be obtained rapidly and correctly enough to produce satisfactory results.

The first utilization of photography in this form was to place a number of cameras in a row, opening and shutting the lenses automatically as the moving object passed before them. Then Edison took up the work, producing the kinetoscope, by which he took a series of photographs on long strips of film, at the rate of some thirty a second. Since that time the further experiments have been merely in the direction of improved mechanical devices for taking photographs with greater rapidity and regularity, and then producing them on the screen by improved lanterns.

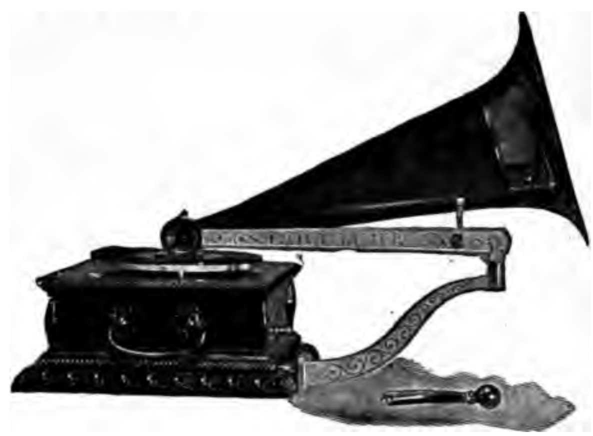
Strips of celluloid, varying in length from seventy feet to 600 feet, are used for making the negatives. They are sensitized the same as are ordinary glass plates or celluloid films for cameras, and are wound upon spools. The camera mechanism is so arranged that this strip of film passes through the camera at the focal point, unwinds bit by bit, stops for a fraction of a second in front of the lens while an exposure is made, proceeds for another inch when the light is cut off, stops again at the right instant for a second photograph, and so continues indefinitely until the whole roll is exhausted. By the delicate mechanism employed 1,000 pictures may be made in a little more than a minute, and each fraction of the film stops for the fraction of the second while the shutter is open, and moves on again while the shutter remains closed.

It is readily seen that to produce a series of pictures of an event extending over a considerable time, an immense quantity of films and an expensive equipment of cameras and mechanism must be provided. When the record is complete, however, the hundreds or thousands of pictures are developed, still on the original rolls, and from the completed negatives a reverse or a positive is made upon other similar rolls of celluloid films covered with gelatine. This is in order to get all the objects into their proper relations of light, either black or white, for in the original negative of every photograph the lights and shadows are exactly reversed.

The picture is now ready to be thrown upon the screen. It is passed through a machine to which a powerful light, such as that of a magic lantern, is fitted. As the pictures pass before the lens they halt briefly, the shutter is thrown open automatically and the view is projected; then the shutter is closed, the film moves on, another picture takes the place of the first, the shutter is opened and another view becomes visible. Moving about fifteen to the second as the pictures do, the eyes' persistence of vision heretofore mentioned retains the image, and gives the impression of an actually moving object. The machines have not become so perfect as to entirely eliminate a slight jerking motion, which results from the imperfections of the mechanism, but they are continually improving. They promise to be of the utmost value in recording for the future the actual processes and facts of many important events of today. With the phonograph to preserve the voices of the great ones of mankind and the kinetoscope to portray their exact movements and manners, posterity will have a fairly complete idea of certain phases of the world as it is now. What would we not give for a series of kinetoscope pictures and phonographic records of the great events of the past centuries? History would take new forms, could such text books be utilized.

THE PHONOGRAPH AND ITS USES

The phonograph, which but a few years ago was an awe-inspiring scientific mystery, used for entertainment in exhibition halls, has been developed to a perfection which puts it in common use in great business offices and educational institutions, for a multitude of practical and familiar purposes.



THE MODERN TALKING MACHINE.

Talking machines under various names, be they called phonographs, gramophones, graphophones or otherwise, are all based on the same general principle. There is a metal cylinder covered with a thin layer of wax on which a pointed pen inscribes tracings corresponding to the vibrations caught by a membrane placed on top of the instrument. The wax cylinder is rapidly revolved by means of an electric battery, and as one speaks in front of the membrane the cylinder advances slowly in a horizontal position, at the same time revolving steadily. The membrane vibrates much or little, according to the sounds produced by the operator. The pen moves according to the vibrations, and peculiar, almost imperceptible, tracings on the wax are the result. A funnel and tube, into which the operator speaks, carry the sound to the membrane.

To obtain reproductions of the sounds as inscribed on the wax cylinder it is replaced in its original position. Another pen of different construction is mounted so that its point retraces the original tracings of the first pen, the membrane is made to vibrate again, and the sound is reproduced through the tube and funnel.

The phonograph is both the ear and the voice. It is a tympanum like the tympanum of the ear, and it vibrates in unison with the sound waves that push against it, but it does more than the ear's tympanum, for it makes a permanent record of what it hears. Like the voice, the phonograph sets in motion waves of sound, but it is not limited, as the voice, to the production of a comparatively few sound waves. Instead, every musical tone or sound of nature, single or complicated, from the delicate whisper to the crashing melody of a great military band, can be recreated.

For purposes of entertainment the phonograph in its various forms has become common, and its cost is but little. The best music, vocal or instrumental; great sermons, orations and lectures, and the dramatic readings of lecturers and elocutionists may be sent the world over, recorded on simple wax cylinders, at small expense, to be reproduced at will or to be preserved until those who spoke or sang have long since passed away.

For business purposes the phonograph is used as a partial substitute for stenographers and secretaries. Business men dictate their letters to the silent machine, which afterwards dictates them in turn to typewriters for transcription. Schools of language have adopted phonographs for the teaching of the foreign tongues. Skilled professors dictate lessons in French, Spanish, German or Italian, and the little wax cylinders repeat them as many times as necessary to the students, thus assuring careful instruction in pronunciation. Other uses of the ingenious instrument are constantly suggesting themselves, and it is now recognized as one of the more important recent contributions of science to the world of practical inventions and utilities.

COMPRESSED AIR AND PNEUMATIC TUBES

The power of compressed air has been utilized for a long time in certain mechanical processes, but by the introduction of pneumatic tube systems the uses of it have been many times multiplied. Air compressed into a smaller space than it naturally demands tends to expand like any other compressed gas. This tendency to expansion, properly directed and controlled, becomes available for a multitude of uses. Inexhaustible as the material is, and transmitting its expansive force for long distances without perceptible decrease by friction, it is easily controlled and in reach the world over.

Among its other simple applications compressed air is used for cleaning dust out of carpets and upholstery. It may be used also for applying paint to high ceilings by means of a spray. Ground glass and glass signs are engraved in whatever patterns desired, by the force of a blast driven by a stream of compressed air. In art it is used for the finishing of crayon portraits, by means of an apparatus called the air brush.

The more important commercial uses to which this natural force is applied are in the transportation of packages and the application of power. Street cars, elevators and automobiles are run by compressed air and it proves to be a safe, convenient, economical and noiseless method of power transmission. The first utilization of compressed air for transporting packages was in the great stores of New York, Chicago and other cities. Pneumatic tubes extending all over these places communicate from floor to floor, and through them little boxes are sent rapidly to the cashier's desk, conveying the money received in payment and returning the change.

From this beginning pneumatic tube systems have been developed in many other places and for more pretentious purposes. In both the cities named, and several others, such systems of tubes buried under the streets convey messages rapidly between newspaper offices and the press associations which supply them with much of their material. An eight-inch tube extending from the New York City postoffice to the postoffice of Brooklyn, over the Brooklyn Bridge, carries many wagon loads of parcels daily, much more rapidly and cheaper than could be done in any other way.

These practical applications have proved the value of such a service, and there is a manifest movement toward the introduction of larger systems wherever traffic demands. Chicago, Philadelphia and New York moved first in the matter, inducing the national government to establish general systems between all the postoffices and branches throughout those cities. A corporation obtained a franchise in Chicago, and built tunnels throughout the business portion of the city, where all the necessary pneumatic tubes for any service demanded could be readily installed, in addition to the telegraph and telephone wires already in service.

The tubes used for these purposes are made of heavy seamless brass, highly pol-

THE YERKES OBSERVATORY, WILLIAMS BAY, LAKE GENEVA, WISCONSIN.

ished inside, and of uniform diameter. The boxes or "carriers" which travel in them are cylindrical, to fit the tube. A strip of sheepskin bound around the box at either end, with the wool outside, makes it tight enough to be carried forward by the force of the current of air, without producing enough friction to bind it in the tube. Light carriers operated with tubes at high pressure travel at the rate of about a mile in three minutes, while heavier carriers are driven a little less rapidly. The systems are somewhat expensive to install, if large tubes are to be buried under ground, but after installation their operation is comparatively inexpensive. It has even been suggested that small passenger cars could be driven through tunnels in the same manner, but no experiments in this direction have been made. For mail and express packages, however, compressed air and pneumatic tubes offer transportation facilities unsurpassed, and the uses of them are growing with the utmost rapidity.

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GREAT AND FAMOUS TELESCOPES

While inventors and scientists in one direction have been improving methods of transportation and communication on the earth by means of railways, telegraphs and kindred appliances others equally energetic have devoted themselves to the effort to communicate with other worlds than this, or at least to study them to better advantage. Telescopes have multiplied and have grown greater and more perfect, as truly as locomotives have done, and they bring the stars nearer to the vision of the observer with striking brilliancy. The United States not only possesses the largest telescope in the world but the second, fourth, fifth and eighth as well, in the first eight.

This largest of all star-gazing apparatus is located on the shores of Lake Geneva, near Williams Bay, Wisconsin. The great telescope and the observatory in which it is mounted were given to the University of Chicago by Charles T. Yerkes, the street railway magnate of Chicago and London. The huge lens of the great instrument has an aperture of forty inches, which is four inches greater than that of the Lick Observatory in California, its nearest rival. The lenses were ground in Cambridge, Massachusetts, by Alvan Clark, whose father was a telescope maker, and whose sons continue the business. The glass proper is composed of two lenses, one of ground glass and the other of flint glass, ranging in thickness from three-quarters of an inch to two inches, and placed eight inches apart. They weigh 500 pounds and were four years in polishing, the final touches being given by the maker's finger tips.

The great tube is sixty-five feet long and weighs 40,000 pounds, yet the whole instrument is so evenly poised that it can be moved by the hand to any angle or position. The dome of the observatory is 90 feet in diameter. Under the telescope is a floor which may be raised and lowered by means of electric motors to whatever height would be most convenient for the observer. The great dome itself is likewise movable, being mounted on car wheels which run on a track around the wall, as is clearly shown in the accompanying illustration. At the will of the operator the whole dome may be revolved above, so that the large opening in the roof may be brought opposite any star. The motive power for the dome is elec-

THE LARGEST AND MOST POWERFUL TELESCOPE IN THE WORLD.

Interior view of the Yerkes Observatory. The tube of the telescope is sixty-five feet long and the lens is forty inches in diameter. The floor is hoisted, the telescope shifted, and the dome turned by electric motors.

tricity, and the great sliding shutters in the roof are also opened and closed by power from the dynamos. Inside the base of the tube is a clock-like arrangement that adjusts various parts of the workings, keeping the lens moving steadily in the path of the star which is being studied. The total cost of the huge telescope and the observatory was $500,000, but the scientific results obtained have justified the cost.

As an accessory to this great instrument the astronomers of the Yerkes Observatory have built a still larger telescope of another kind. It has no great dome over it, no tube containing great lenses, and nothing to suggest its purpose to the stranger. In appearance it is merely a long wooden shed, about eight feet wide and about the same height, with a gable roof, built flat upon the ground and extending to a length of 165 feet. It is open at one end, and it suggests nothing as much as a long corn-crib or chicken-house without doors or windows. A thirty-inch mirror, mounted at the open end of this peculiar horizontal telescope, reflects the stars' rays into the long horizontal tube, to a concave mirror at the other end, which will focus the rays either upon a photographic plate or into the slit of the spectroscope.

With this instrument photographs of eclipses, stars and other astronomical subjects can be made with great success. It is no longer sufficient to watch the stars through a revolving telescope. The apparatus adapted for the various purposes of astronomy takes widely different forms, and the most complete observatory is the one most fully equipped. It is believed that the horizontal telescope at the Yerkes Observatory is but the forerunner of another many times as large. Already one a thousand feet in length is contemplated. The forty-inch telescope mounted in the dome gives a photograph of the moon seven inches in diameter. The completed horizontal telescope makes the moon appear more than nineteen inches across. Through the 1,000-foot telescope the observer will behold a moon 109 inches in diameter. Every little detail will be enlarged and the 8 by 10 plates now used to cover the whole image will then be used to obtain a picture of a single crater or some dark valley of the moon. With such keen scrutiny turned upon the heavens we may expect noteworthy discoveries in astronomy before many more years have passed.

SIZE OF GREATEST TELESCOPES IN THE WORLD

Name.	Place.	Inches aperture.
Yerkes Observatory,	William's Bay, Wis.	40
Lick Observatory,	Mt. Hamilton, Cal.	36
Imperial Observatory,	Pulkova, Russia	30
Naval Observatory,	Washington, D. C.	26
University of Virginia,	Charlottesville, Va.	26
University of Vienna,	Vienna, Austria	26
Greenwich Observatory,	Greenwich, England	26
Halsted Observatory,	Princeton, N. J.	23

The list of those from 18 to 6 inches aperture is too numerous to tabulate.

TELEPHONES, THEIR MECHANISM AND DEVELOPMENT

The telephone itself has become exceedingly common within comparatively few years since its invention, but the improvements and applications of it which are made from time to time continually prove anew the remarkable value of the invention in its everyday uses.

The principles of the telephone are not extremely complicated, in comparison with those of other electrical appliances. It is well understood that when a person talks, sings or whistles, he produces sound waves which are carried through the air, for the particles of air are thrown into vibration which is carried along from one particle to another. Similar sound waves or vibrations are transmitted through solid bodies when sound is made adjacent to them. It has been found that all sorts of substances which are capable of being vibrated transmit sounds, some with poor success, and others, such as iron, steel, silver and well seasoned wood, to a surprising degree. Many experiments have been made in the transmission of sound by electricity and vibrations in solid bodies, but it was not until 1876, our American Centennial year, that Professor Alexander Graham Bell produced the speaking telephone which in its improved shape is the telephone used almost exclusively to-day.

PART OF OPERATING ROOM IN A TELEPHONE EXCHANGE.

The portion of the modern lampline multiple switchboard here shown requires six miles of silk and cotton insulated cables to connect it with the distributing racks.

A thin, flat, circular piece of iron called the diaphragm is the essential factor in the transmission of sound through the telephone, while a similar diaphragm in the receiver at the other end of the line conveys the sound to the ear of the listener. When the voice is directed into the transmitter of the telephone, the diaphragm shakes or vibrates, because the voice makes sound-waves which strike it and set it in motion. Now the diaphragm is so sensitive to these sound waves that it moves back and forth faster or slower according to the length of their vibrations. These movements of the diaphragm in the transmitter cause different kinds of currents of electricity, supplied by a battery in the instrument, to flow over the wire to the diaphragm in the receiver. This latter one then vibrates exactly as the first one does, and sets in motion sound waves exactly like those made by the voice in the transmitter. Thus it is that one may be heard to speak at a great distance through the telephone.

Magnetism and electricity work together in the telephone. If some wire be wound around a piece of soft iron and a current of electricity be sent through the wire, the iron at once becomes a magnet and will remain a magnet just as long as the electricity is flowing through the wire. The instant the current is shut off, the iron ceases to be a magnet and becomes only a piece of iron again. A magnet made in this way is called an electro-magnet and the two forces of magnetism and electricity are very closely related. If a piece of steel, however, be magnetized, it becomes a permanent magnet. In the receiver of the telephone, in the part which one holds to the ear for hearing, is a permanent magnet made of four strips of steel, each of which is magnetized separately. At one end of this bar magnet is an electro-magnet, with fine copper wire wound on a spool around the iron core or center which is attached to the steel magnet. Two small copper wires lead back from the electromagnet to the closed end of the receiver, where they connect with the green covered cords which contain the wires leading through the instrument on the wall to the wires which reach the outer world.

At the open end of the receiver appears a diaphragm fitted so closely to the iron core of the electro-magnet as almost to touch it. In the transmitter there is a diaphragm, but no magnet. Instead of the magnet is a little platinum knob on the end of a slender spring which rests in the center of the diaphragm, and which in turn presses against a carbon button on the end of another spring. The wires from the platinum and carbon run to a little cylinder of coiled wire called the induction coil. The transmitter is an electric instrument, and in that respect is widely different from the receiver, which is a magnetic instrument. It so happens that an electric telephone is best for the speaking end, and a magnetic telephone is best for the hearing end.

There are many more scientific details that might be explained, but the foregoing facts are the essentials in connection with the simplest form of telephones. In usage the telephone is becoming more essential every day. At first its limit was the transmission of speech for a very few miles, but now distance seems to be no barrier. Long distance telephone service is now maintained without difficulty throughout all the states east of the Rocky Mountains, and one may talk to his friend in direct conversation between places as widely separated as Montgomery, Alabama; **Hastings,** Nebraska; Bangor, Maine, and Richmond, Virginia, with all intervening cities of prominence accessible by connecting lines.

And still in the United States we are behind some other countries in the quality and cost of our telephone service. The Swedish instruments excel ours in the distinctness and ease with which they transmit the human voice. They are used in many countries, and wherever they are used are highly favored. With them persons conversing are not required to listen intently with the receiver at the ear, nor yet to speak directly into the transmitter, but they carry on their conversation with perfect ease, although clear across the room from the telephone itself. In the Australian colonies the telephone is a part of the post-office department, and there is a fixed charge of $18 a year for the service instead of prices ranging from $50 to $200 a year as in the United States. One result of this is that telephones are found everywhere. It is an interesting feature of the telephone system in Australia that it has been extended to remote sheep stations, many miles from the cities and towns, and the telephone wires are strung along fence posts between two of the barb wire strands, thus obviating the necessity of erecting poles.

PART OF DISTRIBUTING RACKS IN REAR OF SWITCHBOARD.

The equipment here shown is sufficient for 3,500 instruments. It includes 3,500 lightning arrestors and 60,000 feet of "jumper wire."

In France a system of military telephones has been developed. A part of each signal corps in the army has been organized into a telephone squad, and each soldier in the squad carries a whole telephonic outfit on his back. In the company service there are four telephone operators, in charge of a corporal, who is the "hello girl" and the "central station" combined. A telephone station is built on the back of each operator and is carried from point to point as if it were a knapsack. In his hand the operator carries a reel of wire holding enough wire, which is made with a steel core surrounded by copper, to run a line of over 6,000 feet. The reel is connected with a sword bayonet, so that the operator by sticking his bayonet into the earth turns it into a ground-wire, for but a single wire is used, the return being an earth circuit.

Small dry batteries are used. In establishing a regimental telephone line, the corporal takes up his station near the headquarters of the commanding officer, and fixing his telephone to his ear, sticks his sword bayonet in the earth and orders the operators to run a line. One of them connects his reel of wire to the telephone on the corporal's back, and starts off in the given direction upon the run, the wire unreeling as he moves forward. He keeps his line of travel as straight as possible, but selects points where the wire can be caught up from the ground on bushes and trees.

Having run out his line of about 6,000 feet, the operator makes the ground connection with his bayonet and calls up central. If all is right, operator number two connects his wire with the line already installed, and runs away until he has unreeled his wire, when he calls up central and operator number three takes up the run, which is finished by operator number four, so that a telephone line of over four and one-half miles is quickly strung by the pedestrian telephonestations. This may be one continuous line, or the four lines may radiate in as many directions from the central station.

CORNER IN TELEPHONE EXCHANGE BATTERY ROOM.
Showing power dynamos for connecting with 2,500 subscribers.

A helper follows the line man and loops up the wire where it is possible on trees and bushes, but where there are none he leaves it on the ground. He also acts as repairer and line man moving back and forth between the stations. The operators have the receivers of the telephone strapped to their ears and thus are ready at all times to receive orders and transmit them. The operators are provided with small camp stools, for sometimes they are stationed in one place for several hours. In such cases the telephone outfit is taken from the back, and leaned up against a stone or tree. At headquarters, during maneuvers, experimental campaigns and sham battles, stationary exchanges are installed with connections made with all parts of the field. In this headquarters central station a small switchboard is used, and the corporal, who is chief operator, receives reports and transmits the orders as readily as if wires were strung on solid poles instead of trailing through the grass over the ground. Cavalrymen are used in this service as well as infantrymen. The ground connection is made through the bit, body and shoes of the horse, while in other respects the operator is equipped with the infantry outfit.

This branch of the service is distinct from the telegraph service, which strings wires or hangs them on the boughs of trees.

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TELEPHONING WITHOUT WIRES

We have had the telephone for more than a quarter of a century in practical working use, and have begun to think of it no longer as extraordinary. In truth, however, the advances and improvements in the ordinary telephone since the first successful experiments were made, mark almost as great progress as did the original invention itself. Of very recent success are the experiments of Marconi with wireless telegraphy, an astounding and important advance over the ordinary system of telegraphy through wires. Now comes the announcement that an American inventor, unheralded and modest, has carried out successful experiments in telephoning and is able to transmit speech for great distances without wires.

The inventor is Nathan Stubblefield. The first public test of telephoning without wires was made at the Kentucky village where the inventor lived, on the first day of January, 1902, only a few weeks after Marconi's success in signaling across the Atlantic by telegraph without wires.

The next demonstration was made ten days later for a newspaper correspondent from St. Louis and the account of it was published in detail in that city. The investigator wrote as follows in regard to what he learned:

"Mr. Stubblefield has worked for ten years to discover an apparatus by which he could overcome the use of wires in telephoning, during which time he has become a technical electrician of high order. He has kept in touch with all the leading electricians, and is familiar with every important discovery in the field of electricity. Naturally he has been a close observer of the work of Marconi.

"The transmitting apparatus is concealed in a box. Two wires of the thickness of a lead pencil coil from its corners and disappear through the walls of the room, and enter the ground outside. On top of the box is an ordinary telephone transmitter and a telephone switch. This is the machine through which the voice of the sender is passed into the ground, to be transmitted by the earth's electrical waves to the ear of the person who has an instrument capable of receiving and reproducing it.

"We went into the cornfield back of the house. After walking five hundred yards we came to the experimental station the inventor has used for several months. It is a dry goods box fastened to the top of a stump. A roof to shed the rain has been placed on top of it; one side is hinged for a door, and the wires connected with the ground on both sides run into it and are attached to a pair of telephone receivers. The box was built as a shelter from the weather, and as a protection to the receivers. I took a seat in the box and Mr. Stubblefield shouted a 'hello' to the house. This was a signal to his son to begin sending messages. I placed the receiver to my ears and listened. Presently there came with extraordinary distinctness several spasmodic buzzings and then a voice which said: 'Hello, can you hear me? Now I will count ten. One—two—three—four—five—six—seven—eight—nine—ten. Did you hear that? Now I will whisper.'

"I heard as clearly as if the speaker were only across a 12-foot room the ten numerals whispered. 'Now I will whistle,' said the voice. For a minute or more the tuneless whistle of a boy was conveyed to the listener's ears. 'I am going to play the mouth organ now,' said the voice. Immediately came the strains of a harmonica played without melody, but the notes were clear and unmistakable. 'I will now repeat the program,' said the voice, and it did.

MR. STUBBLEFIELD RECEIVING MESSAGES BY WIRELESS TELEPHONE.

Note the two steel rods in the ground, which establish connection with the electrical currents of the earth, being connected by 30 feet of wire attached to the receiver.

"An examination of the station showed that the wires leading from the receivers terminated in steel rods, each of which was tapped with a hollow nickel-plated ball of iron, below which was an inverted metal cup. The wire enters the ball at the top and is attached to the rod. The rod is thrust into the ground two-thirds of its length. Another test was made after the rods had been drawn from the ground and thrust into it again at a spot chosen haphazard by the correspondent. Again the 'hello' signal was made by Stubblefield, and after a few minutes wait came the mysterious 'Hello! Can you hear me?' and a repetition of the program of counted numerals, whispers, whistling and harmonica playing.

" 'Now,' said Mr. Stubblefield, who carried under his arm duplicates of the ball-tipped steel-rods. 'I wish you would lead the way. Go where you will, sink the rods into the ground and listen for a telephone message.'

"Away we went, down a wagon track, through the wide cornfield. A gate was opened into a lane between the hedge that bordered the field and a dense oak woods. We pursued the lane for about 500 yards and struck into the woods. I led the way. Into the heart of the woods we walked for nearly a mile. In a ravine I stopped. 'How far are we from the house now?' I asked. 'About a mile,' Stubblefield answered. 'Place the rods where you will and listen for a telephone message.'

"I took the four rods from Stubblefield. Each pair of rods was joined by an ordinary insulated wire about 30 feet long, in the center of which was a small round telephone receiver. Two of the rods were sunk in the ground, about half their length, the wires between them hanging loosely, and with plenty of play. I placed a receiver at each ear and waited. In a few moments came the signal and the voice of Stubblefield's son. The voice was quite as clear and distinct as it was 500 yards from the transmitting station. The rods were moved here and there, but always the message came."

Nathan Stubblefield comes from a family distinguished in his locality. His father was a lawyer, much respected in that part of Kentucky. His brothers are merchants and leaders in the community. But Nathan Stubblefield is another type. He cares only for his home, his family, and electricity. He educates his children in person, and after seeing that his family is well provided for, spends the remainder of his substance in electrical experiments.

His son, Bernard B. Stubblefield, 14 years of age, has been for four years his father's sole assistant. He is a remarkable boy. His father has been his only educator, and the lad is now an expert electrician and reads abstruse works on electricity and technical electrical journals with the same zest that other boys read stories of travel and adventures. His father says of the boy that he would be able to carry out and finish this system of wireless telephony should the father die, so closely has he been allied with every step in its discovery and development.

"I have been working for this, ten or twelve years," he said. "Long before I heard of Marconi's efforts, or the efforts of others, to solve the problem of transmission of messages through space without wires, I began to think about it and work for it. This solution is not the result of an inspiration or the work of a minute. It is the climax of the labor of years. Of course I worked along the lines all the others are working. The earth, the air, the water, all the universe, as we know it, is permeated with the remarkable fluid which we call electricity, the most wonderful of God's gifts to the world, and capable of the most inestimable benefits when it is mastered by man. For years I have been trying to make the bare earth do the work of the wires. I know now that I have conquered it. The electrical fluid that permeates the earth carries the human voice, transmitted to it by any apparatus, with much more clarity and lucidity than it does over wires. I have solved the problem of telephoning without wires through the earth, as Signor Marconi has of sending signals through space. But

I can also telephone without wires through space as well as through the earth, because my medium is everywhere.

"As to the practicability of my invention, all that I claim for it now is that it is capable of sending simultaneous messages from a central distributing station over a very wide territory. For instance, any one having a receiving instrument, which would consist merely of a telephone receiver and a few feet of wire, and a signaling gong, could, upon being signaled by a transmitting station in Washington, or nearer, if advisable, be informed of weather news. Eventually it will be used for the general transmission of news of every description. I have as yet devised no method whereby it can be used with privacy. Wherever there is a receiving station the signal and message may be heard simultaneously. Eventually I, or some one, will discover a method of tuning the transmitting and receiving instruments so that each will answer only to its mate.

"I claim for my apparatus that it will work as well through air and water as it does through the earth. That it will convey messages between the land and sea, for instance, from lighthouses to ships, from vessels in any part of the ocean to vessels or their owners on land, if each carry my transmitters and receivers; it can be used on moving trains so that they may be spoken between stations and thus prevent accidents. There is no conceivable position or station in which they may not be used. The all-enveloping electricity, the medium of carriage, insures that. The curvature of the earth means nothing to me—it will not deter messages sent by my apparatus. I have shown what my machine will do through the earth by grounding the wires. I will say that it is not absolutely necessary to ground the wires. I can send messages with one wire in the ground, the other in the air, or with no wires at all. In fact, my first and crude experiments were made without ground wires. I have sent messages by means of a cumbersome and incomplete machine through a brick wall and several other walls of lath and plaster without wires of any description. The present method of grounding wires merely insures greater power in transmission. Several years ago I invented an earth cell which derived enough electrical energy from the surrounding source to run a small motor continuously for two months and six days without being touched. There was enough energy in the motor to run a clock and other small pieces of machinery or ring a large gong. This earth cell can be greatly magnified. Its discovery was the beginning of my experiments with wireless telephony. The earth cell was merely buried in the ground and connected by wires with the motor. The earth's electrical currents supplied it with power. The expense of my wireless telephony apparatus will not be great—not greater than that used for ordinary telephoning, minus the present enormous cost of wiring."

In May Mr. Stubblefield went to Washington and conducted a public test in the presence of a number of scientists and capitalists from New York and Chicago. These tests were made on board a steamer on the Potomac River and on land nearby. During the land tests, complete sentences, figures and music were heard at a distance of several hundred yards, and conversation was as distinct as by the ordinary wire telephone. Persons each carrying a receiver and transmitter with two steel rods, walking about at some distance from the stationary station, were enabled to instantly open communication by thrusting the rods into the ground at any point. An even more remarkable test resulted in the maintenance of communication between a station on the shore and a steamer anchored several hundred feet from the shore. Communication between the steamer and the shore was opened by dropping the wires from the apparatus on board the vessel into water at the stern of the boat.

An interesting article by Professor A. Frederick Collins, the well-known electrical scientist in the "Electrical World and Engineer," relates his observation of the demonstrations of wireless telephony and gives his opinion as to the practical value of the invention. He says in part:

"There are many instances where an ordinary telephone cannot be employed. As an illustration let me cite a few cases: Two families lived only 1,500 feet apart, and where telephones costing $25 per pair would have answered the purpose, but owing to a railroad operating the adjoining properties, permission could not be obtained to stretch the wires; as an experiment the wireless telephone was tried, and with success. Another case was in the Thousand Islands, where a cable was laid from an island to the main land, at a cost of $2,000; here, again, a wireless telephone could have served the purpose at a cost not exceeding $200. A third case is in Narbeth, where the borough officials will not permit the Bell Telephone company to erect

NATHAN STUBBLEFIELD AND HIS SON TRANSMITTING MESSAGES BY WIRELESS TELEPHONY.

poles. Two physicians have had telephones in their residences for nearly a year, hoping that the Bell people would effect connection with their lines, one-fourth and one-half mile away. The contention was a matter of one narrow street. This distance could have been easily bridged by means of a wireless telephone; in fact, communication was established between one of the residences and the writer's laboratory, where three streets intersected the line of wave propagation, but as it took place under the surface of the earth, no one objected to it. But the most useful sphere of the wireless telephone, and the one which the writer has ever advocated, is its application to vessels in harbors. The wireless telephone is a first-hand instrument; it is simple, reliable, and it may be applied to any vessel at a comparatively small cost.

"The synchronization of wireless telephony is one of the knotty problems. It is this question that staggers the most sanguine; but if one had asked Professor Bell, in 1876, how any two of 40,000 subscribers might be put into instant communication one with the other, he, doubtless, would have found it difficult to even picture in his mind's eye the modern central station switchboard. It must be remembered that the wire telephone has had engaged in its improvement the brightest scientists, the most original investigators of the world for a period of over a quarter of a century, and this experience and application has brought the 'toy' to be one of the most potent factors of the commercial world. Would that a little of such applied energy could be put on the wireless telephone."

As an evidence that the practical value of the wireless telephone is recognized, the Gordon Telephone Company of Charleston, South Carolina, promptly ordered a complete equipment to connect that city with the sea islands along the coast. Only a year before, that company spent $25,000 in one winter to install and maintain its marine cables, and the president of the company estimated that an equally satisfactory service by wireless telephone would have cost but $2,500 to install.

Wireless telephony stands in practically the same position that wireless telegraphy did prior to 1897, for the reason that its great value is not realized, since it has not been tried by the crucial test of commercial usage. As a consequence there are very few persons engaged in solving the riddle of making it an instrument of wide range and indispensable utility. Nevertheless, in England and France various inventors are now making experimental tests looking for the same results.

At the end of July, 1902, an English company announced its incorporation and immediate readiness to supply wireless telegraph equipment of the Armstrong-Orling system, claimed to be much simpler, cheaper and more perfect than that of Marconi. Wireless telephone apparatus also was offered by the same company, the complete outfit for short distances to cost but $20, with a yearly royalty of $5. Thus it is that the advance of science and invention fully keeps up with the most rapid material progress of the world.

PERPETUAL MOTION MACHINES

Perpetual motion was a will-o'-the-wisp that led philosophers, scientists and mechanics a merry dance for many years. Men of wide thought and deep learning spent the best years of their lives trying to find the missing link which might give them a self-acting machine, that would produce power out of itself and by itself and yet never run down. The present generation of mechanics, however, have had little to do with perpetual motion. They have laid it on the shelf along with other demonstrated impossibilities and chimeras.

Occasionally some one will bring forward a combination of wheels, gears, levers and cams which he declares is a perpetual motion machine, but he receives nothing but jeers for a reward. In the earlier part of the nineteenth century, however, men believed that a self-acting perpetual motion machine was a possibility, and a century earlier many patrons of the arts proved easy victims of frauds and charlatans, who concealed spiral springs and clock work in the cases of their machines, and thus proved that they had discovered how to make an impossibility possible.

A favorite idea which the old-time perpetual motion enthusiasts thought to make practical was the overbalanced wheel, in which weights rolling down toward the rim on one side increased the leverage on that side, because the rolling weights moved toward the center on the ascending side. A simple test showed that the weights would not roll of their own accord, and the inventor bent his energies toward the construction of mechanism which would make the weights obedient.

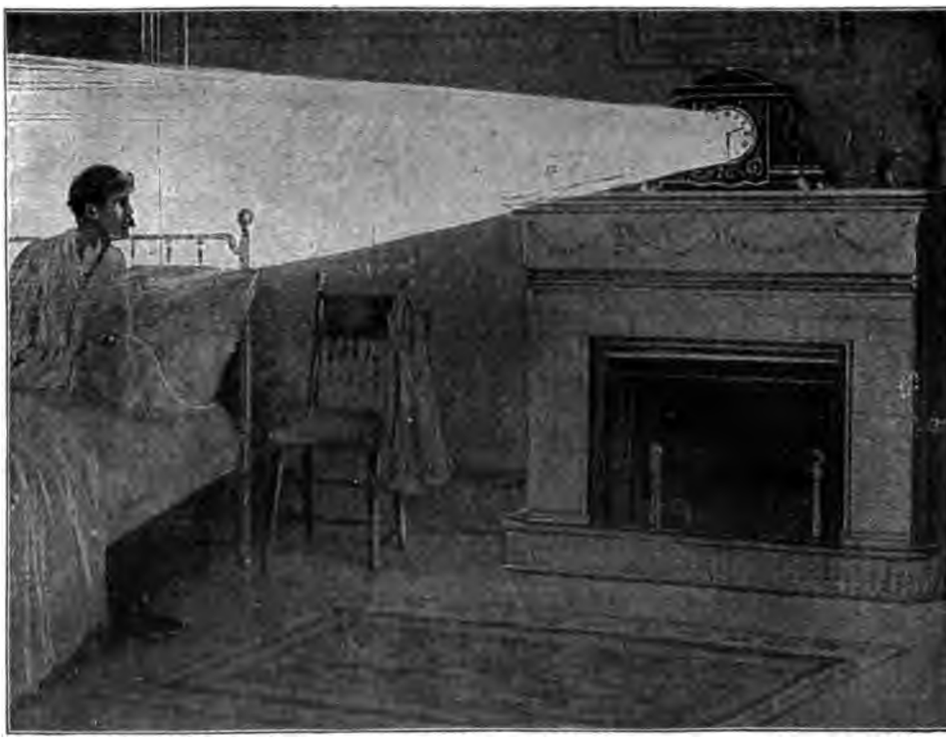
Hydraulic power was the fundamental principle on which numerous perpetual motion machines were based, and pumps were connected with water-wheels in order that the water, having done its work on the wheel, would be pumped to a height to work over again. Capillary attraction was seized upon by several perpetual motion mechanics as a source of energy, and levers, springs, screws, cams, eccentrics, weights, air, quicksilver, gas, the wind, heat, steam and magnetism were used for the purpose of bringing perpetual motion into the field of applied mechanics.

Some of the attempts made to secure the desired results produced machines curious and interesting. One of them used bellows which blew up bladders attached to the arms of a wheel in a tank of water. This was brought out in England in 1823, but as usual there was a missing link. Soon after this machine was given to the world another genius produced a combination water-wheel and a rotary pump affair, which he declared would certainly run itself, through all time. The Archimedes screw was utilized by another pursuer of perpetual motion. All of these devices were brought out during a widespread discussion in England of the mechanical possibilities of perpetual motion. The agitation was contemporaneous with the invention of the steam locomotive, and all England was excited over the possibility of power producers. Engineers, mechanics, scientists and chemists took up the fad, and perpetual motion was a living issue. Finally level-headed men combined to fight the crazy notion, and their exposures of the many frauds which were foisted on the people killed the chimera and it was placed in the grave with other picturesque hoaxes.

CLOCKS WHICH FURNISH LIGHT

If a recent invention in the way of timepieces comes into general use, we will no longer need to be troubled by groping in the dark for matches, when we wake up in the night and want to know what time it is. One of the big clock manufactories of the United States has begun to make and sell an ingenious time-piece called the Aladdin clock. The dial or face of the clock upon which the figures are painted to indicate the hours, and over which the hands pass as they turn, is made of translucent glass, a quality which does not make itself apparent under ordinary circumstances, because there is no light behind it, and consequently it appears like any other enameled clock dial. As a matter of fact, however, it is not so simple.

Behind the glass is an electric light, inside the clock, which is connected with a push button on the end of a long, flexible cord in the interior of which wires are carried after the fashion of electrical connections. This push button is supposed to be safely stowed away under the sleeper's pillow when he retires, or else hung from the ceiling above his head or over the bedpost, as may be most convenient for him. Now let the darkness come when it will. If he wakes in the night to find an intruder in the room, or as a result of sleeplessness, a slight pressure on the button will flood the room with light in a most mysterious fashion from this ingenious clock face, without any noise or without any stirring from his position.



"ALADDIN CLOCK," EQUIPPED WITH ELECTRIC CONNECTION FOR NIGHT USE.

It is quite evident that such a time-piece has several distinct advantages which are bound to make it popular for many uses. It is this sort of thing that may be termed a genuine "Yankee notion," and gains for the United States the distinction of being a nation of ingenious and deft contrivers, who can improve anything if they will only give their attention to it.

ACETYLENE GAS

Within comparatively recent times a remarkably successful illuminant has been introduced under the name of acetylene gas. It has become familiar rapidly as a satisfactory light for buildings, both public and private, and has gained great popularity for carriage and bicycle lamps. Its brightness shows far through the night, and a bicycle lamp equipped with the acetylene light is readily distinguishable from its less brilliant rivals on the road.

Acetylene is generated when calcium carbide is put into water. Calcium carbide is a hard, porous, grayish material, produced by fusing pulverized coke and air-slaked lime in an electric furnace. One ton of this carbide makes 11,000 cubic feet of acetylene gas, which, it is said, is equivalent in illuminating power to 264,000 cubic feet of ordinary coal gas.

The processes of the manufacture of carbide are as follows: Two thousand pounds of lime and 1,500 pounds of coke are placed in an electric furnace, and the product is a ton of calcic carbide. The coke is crushed and pulverized by suitable machinery, and the lime is slowly air-slaked and then is thoroughly mixed with the coke. The electrical furnace is built of firebrick, and in it is a cast-iron crucible about two by three feet in size.

The cast-iron plate in the bottom is protected from the intense heat of the electric arc by a thick layer of powdered carbon, which is a good conductor of electricity but a poor conductor of heat. This plate forms one of the "electrodes" or poles of the electric cable, which conveys the current to the furnace. The other electrode is a large pencil of carbon, which hangs vertically over the plate. It is so arranged that it can be lowered until the carbon touches the plate, or drawn up and out of the furnace altogether. It is connected with the other electric cable, both running from an alternating generator.

The carbon pencil is an important part of the outfit. It is made of six carbon slabs, each three feet long and four inches square, clamped together so as to form a composite pencil having a cross section of ninety-six square inches. The spaces between the carbon slabs are filled with powdered coke and coal tar, rammed down hard and afterward baked, so that the pencil is practically one piece of carbon and is used as such.

When the current is on, an electric arc, similar to that formed in an ordinary arc light but many times more intense, hotter and more brilliant, is formed between the cast-iron bottom plate and the great carbon pencil. The heat from this arc is so intense that it fuses the coke and lime into a solid mass.

When the furnace is ready to be charged the carbon pencil is lowered until it touches the bottom electrode, and the mass of combined coke and lime is shoveled in around it. Then the doors are tightly closed and the current switched on. So long as the pencil touches the bottom electrode nothing happens except that the current flows through the pencil and bottom plate without raising a disturbance. But a great change takes place when the attendant, by turning a hand-wheel, lifts the pencil a short distance from the bottom plate. The current then leaps across the space and the electric arc bursts out, fusing the lime and coke around it, thus making calcic carbide.

As the fusing continues the pencil gradually is lifted higher and higher, for the calcium carbide is an excellent conductor, and the electric arc is maintained in all of its intensity. When the pencil has reached its highest point the current is turned off, and the contents of the furnace are allowed to cool. The product is in the form of a cone of calcic carbide, surrounded by the lime and coke which was outside of the influence of the arc. Although the heat of the furnace is intense, the coke and lime will not fuse unless it is in the fusing zone of the arc. The carbide remains unchanged in dry air, but if it is moistened it gives out a thick, heavy gas, which has a slight smell of garlic in it, and this is the acetylene gas.

The calcium carbide, when placed in water, forms a carbon vapor by the chemical combination of two parts of carbon with two parts of hydrogen. The oxygen combines with the calcium. The gas can be used in many ways. It can be distributed through street mains, as ordinary gas is distributed, but this plan is not regarded as the best, because of the great cost of installation and the leakage. The carbide cones themselves can be delivered to residences, and a small automatic generator connected with the gas piping of the house will take the place of the gas meter. It is easy to liquify this gas, and the liquid gas can be stored in small tanks, delivered to houses and tapped from reservoirs fitted with proper expansion valves. Plants for the manufacture of this gas for use on farms and country estates can be built at small cost, with the result that superior illuminating gas may be used far from the city.

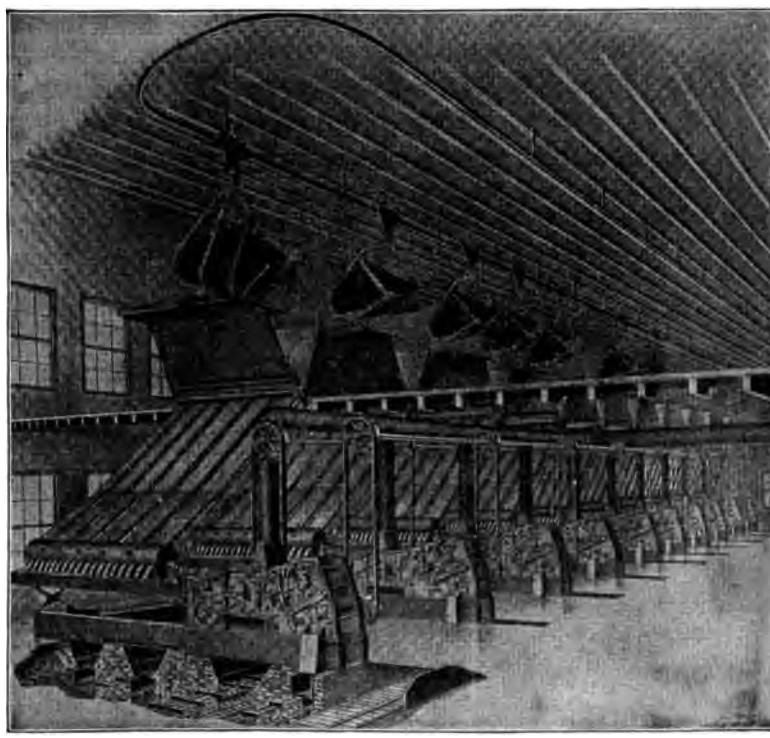
The lamps for bicycle use have small compartments in which the carbide and water are kept separate, the water being allowed to drip through a very small hole, one drop at a time, and as the gas is generated it flows out through a jet where it is lighted. This gas gives out no odor or smoke when burning, but has a decidedly disagreeable smell if it escapes without being burned, and this odor will betray a leak instantly. The appliances for using it are being improved constantly to make it safe in handling, and there is no doubt that it is an important addition to the list of illuminants in general use.

FINDING VALUE IN CORN STALKS

It has long been realized that a valuable product of the farm was going to waste because of the failure to utilize corn stalks to good advantage. Little use has been made of them except as fodder and fuel, although it has been understood that they contain many elements of commercial value, if some method of making them available could be discovered. Many scientists have turned their attention to this matter, with varying success, until finally a process and a machine have been invented which seem to promise an important development in this direction.

The farmers of the United States of America cultivate more than 80,000,000 acres of corn each year and this enormous crop, under present methods, has been raised almost entirely for the kernels. A few husks have been saved for mattresses, and a slight per cent of the fodder has been fed to stock, but it may be stated roughly that of this great crop hardly more than one-half is saved and utilized. It is declared that by processes now developed the part which has been wasted can be turned into meat, paper, and other products of high value. The processes contemplate utilizing every bit of the waste portions of the product.

Each ear of the corn is covered with several layers of husks. Those next to the ear are fine and delicate; those on the outside are coarser. The finer husks have a commercial value outside of their use for feed, being worth several dollars a ton for mattresses and upholstery material. The leaves of the cornstalk are long and tender, and cure naturally in the field. They are of a high feed value, almost wholly digestible, as the per cent of fiber in them is small. The leaves, together with the coarser husks from the ear, are to be preserved in this process as valuable winter feed for stock.



MILL EQUIPPED FOR TREATING CORNSTALKS.

The shell and pith of the stalk are direct opposites to the leaves in composition. When matured the shell becomes hard, dense and woody, and after being treated in a strong solution of lime will produce over sixty per cent of fiber from 100 pounds of stock. In fact there is almost no digestible matter in the shell after it becomes dried. Within the shell is the pith, which amounts to 23 per cent of the clean stalk. This pith has the power of absorbing liquid faster and in larger quantities than any other known substance. A pound of dried pith will absorb twenty-five times its weight of moisture. The stalk, shell and pith of the corn stalk are recognized as having virtually no food value, for an animal fattens on what it digests, not what it eats.

The ingenious machine which has been invented to utilize the waste products of the corn plant, separates all of these different elements with the utmost ease, so that each one of the by-products can be treated on its merits. The de-pithing machine, when stalks are fed to it as they are cut and brought from the field, snaps off the ears and drops them on the husking-rolls, while the stalks themselves pass into another portion of the apparatus. The husking-rolls husk the ears, delivering them to a conveyer, and the husked ears pass into a corncrib. The husks themselves pass into the bin. The leaves are next stripped off the stalk and are then drawn from the machine to another bin. The dirt, too, has been cleaned away in the process. The clean stalk next passes into the de-pithing section of the machine, where the shell and the pith are separated and deposited on separate conveyers. Thus the component parts of the corn plant are separated, so that all can be used for whatever purpose they are adaptable.

It is believed that as these machines multiply there will be some remarkable developments in the manufacture of paper. To-day the forests of our country furnish most of the fiber out of which the ordinary grades of paper are made. These forests do not renew themselves, so that the supply of paper stock is rapidly being reduced. Successive corn crops, however, are raised every year on the same field, and with the shell and the pith of the corn stalk used in the manufacture of paper stock, there will be a noteworthy change in the paper trade. Not only paper, but a multitude of other articles made out of wood pulp can be made out of these hitherto waste products of the corn stalk. With these machines put into practical operation throughout the states of the immense corn belt, the farmer should find a great increase in his income from the corn fields. Hitherto the farmer has received his profit only on the ears of corn. If to this we may add several dollars an acre for what has been considered a waste product, it will go far to increase the profits of farming in the Mississippi valley. It is estimated that the annual waste of corn stalks in the seven leading corn-producing states is nearly 60,000,000 tons, valued, if utilized in this manner, at three dollars per ton. An increase of $180,000,000 in the farmers' income in these seven states annually would be an item of striking importance.

The tendency of great commercial undertakings in this age is to eliminate waste. The Chicago packing houses are famous largely because there is no waste permitted, but some use is made of every ounce of the animals slaughtered there. The utilization of what were formerly considered waste portions has made the great profit of those concerns. The utilization of the cotton-seed for oil and cattle feed saves to the cotton growing states about $60,000,000 a year, a sum contributed by what was but a few years ago an absolutely waste product, a nuisance to the planter, who was seeking some cheap way to get rid of it. Most careful attention should be paid to the development of this new process for utilizing corn stalks, in the hope that a similar saving will be made for the farmer of the north.

SAVING GOLD FROM SOOT

In 1900, while workmen were making repairs to the roof of a building in the Omaha plant of the American Smelter and Refining Company, they were amazed to find the shingles and boards covered with atoms of metal. One of the boards was taken to the assayer, who burned it, retorted the ashes and imparted the startling information that the metal was composed of gold, silver, lead and copper.

Other boards were burned with like results, and the mystery grew more perplexing. Finally some one standing on the roof of the building had occasion to brush from his coat sleeves flakes of soot which were dropping from the great, rolling clouds of smoke and gas emerging from the giant stacks near by, and found bits of metal, which gave an idea to those who were investigating the puzzle.

Sheets of common cheese cloth, cut to fit the interior of the stacks, were prepared. Through the center of the sheets were cut holes large enough to allow the necessary free draught. The sheets were fastened at various heights in the stacks and allowed to remain in position for several weeks. When removed and subjected to treatment the chemist produced gold, silver, copper and lead worth hundreds of dollars.

More cheese cloth catchers were inserted in the smokestacks, a few feet apart, one above the other, from the base to the crown. A semi-circular steel house was built, extending from the furnaces to the base of the stacks; a blower was placed in position to cool and force the smoke and gas through the steel house and up the flues. In its passage the smoke deposited in the steel house hundreds of pounds of grime, which was allowed to gather and pack for six months. That of the grime which managed to travel through the circular house and reach the flues was caught by the cheese cloth, a very small portion, practically, escaping to the outside.

When the steel house became filled with packed soot—highly inflammable—the mass was touched off with a common match and allowed to burn for several days, after which it was found that there still remained in the inclosure many tons of a peculiar, dead-looking cinder, hard and worthless in appearance. This cinder was run through the furnaces, receiving treatment in the same manner as the original ores, and readily yielding its precious wealth.

Twice a year the Omaha plant gathers a six months "smokehouse and cheesecloth harvest," receiving 500 tons of cinder, which yields more than $25,000. Fifty thousand dollars per year scattered over Omaha in smoke! That's what it has amounted to for twenty years.

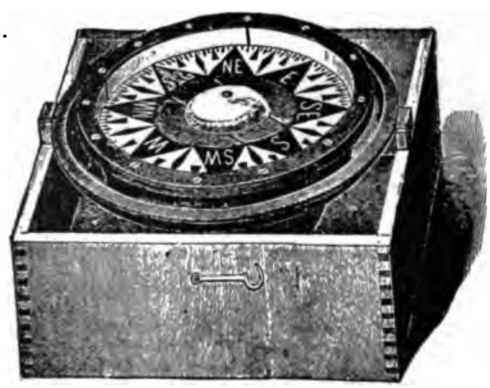
THE MARINER'S COMPASS

The mariner's compass frequently is referred to as an example of constancy and fidelity, and as an unerring guide whose "needle ever points to the north." The "needle which guides the travelers of unknown wastes" has been endowed by writers and poets with all of the virtues commonly supposed to reside in gravity, the earth's orbit, the sun, and other things unchangeable. As a matter of fact, however, the magnetic needle in a ship's compass does not always point to the real north; it is not "ever constant;" it is as susceptible to errors as other products of man's hands, and no navigator who knows his business will take his oath that his compass is absolutely correct at all times.

If the little bar magnet which swings in a compass were left undisturbed by outside influences; if it were delicately poised and nicely adjusted; if there were no iron, steel or other metals susceptible to magnetism in the vessel, and if the magnetic pole and the geographical pole were one and the same, the needle, probably, would ever and always point to the north. But the magnetic pole is not the geographical pole.

The earth, itself a great magnet, has its negative and positive poles, just as the smallest horseshoe magnet, or the tiniest bar magnet has, but the earth's magnetic poles are always moving, and this movement, constant though slow, causes that "variation" which keeps navigators and scientists on guard, making observations, drawing magnetic charts, and searching for the cause of this pole traveling.

A bar magnet is a straight bar of steel which has been permanently magnetized. If a horseshoe magnet were straightened



THE MARINER'S COMPASS.

out, it, too, would be a bar magnet, with its positive and negative poles at opposite ends. Midway between the poles in a bar magnet is a point where the magnetism is neither positive nor negative. This is the neutral ground.

If a slender piece of wire, or a steel needle, is suspended in its center by a thread over a bar magnet, the negative end of that needle will point toward the positive end of the magnet, or the positive end will point to the negative pole. If the needle is held directly over the neutral part of the magnet it will hang horizontally—parallel with the magnet. If it is moved toward one of the ends of the bar magnet one end of the needle will dip toward it, and the nearer it is moved to the end of the pole the more the needle will dip, and when directly over the pole it will dip as nearly straight downward as the thread will permit.

If that bar magnet is placed in a bucket of water so that it is just on the surface, and the needle is pivoted on a bit of cork large enough to make it float, the positive end of the needle will point toward the negative pole of the magnet, and the negative end toward the positive pole of the magnet. If the needle is floated opposite the center of the magnet, it will swing around parallel to it; as it is moved toward the pole one end will swing more and more, until the needle stands at right angles to the end of the bar.

If the magnet is placed under the surface of the water an inch or so, the needle not only will point toward the pole which attracts it, but will dip toward it also, and this is just what happens to the needle in a mariner's compass. It not only swings horizontally, but it dips downward also, just as though an immense bar magnet pierced the center of the globe, with its north and south poles sticking out at the magnetic poles of the earth.

To compensate for this dip, the compass needles or cards are provided with sliding weights, or other adjustments, so that they will be kept on a horizontal plane. From the poles of every magnet invisible "lines of force" shoot out and curve back toward the center of the magnet. The space cut by these lines of force is called the "magnetic field," and when in this magnetic field a freely poised needle will always place itself parallel to the lines of force.

From the magnetic poles of the earth, lines of magnetic force curve and twist out so that the whole globe is covered with them. Midway between the poles this magnetic force is weak, near the poles it is strong, so that the nearer a ship sails to a magnetic pole the steadier the compass becomes.

But there are other influences which affect the compass in a ship, and the most important one, outside of the variations of the world's lines of force, is the iron and steel which go into the making of a ship. No material has been found which will insulate the magnets in a compass, and the immense amount of metal in a ship serves as a large magnet to disturb the needle or magnetized steel wires in a compass. Many methods have been tried to correct the errors caused by iron and steel in a vessel, but the careful captain trusts to nothing but eternal vigilance and constant testing.

The little pocket compass, with its trembling needle shivering on its pivot, would not be able to meet all of the requirements for a ship's compass. In fact, the ordinary compass used in the wheel house of a vessel has no needle at all, for the magnetic steel bars which are used are concealed in the "card" that seems to swing from one side to the other with every movement of the ship.

As a matter of fact, the card is stationary. It is the vessel which moves, and an optical illusion gives motion to the card. A standard compass, such as is used on ocean vessels, is a complicated piece of sensitive mechanism compared to the little pocket compass which boys delight to carry.

The case which holds the compass is the binnacle, and it is fastened securely to the deck of the vessel or the floor of the wheel house. It is provided with a lamp which is so arranged that it throws its light on the card in the compass, and nowhere else. The compass proper swings on two rings. The arms of the outside ring have knife edges, which rest on the binnacle. On this ring the arms of the inside ring are suspended, so that the compass is always held level, no matter how much the vessel rolls and pitches, for the two rings make a sort of universal joint.

The inner ring holds the copper bowl in which is the card. The card rests on a brass spindle which supports it on its upper end. The card consists of a metal rim, somewhat dished, on which the points and degrees are marked. Several brass tubes, four generally, extend across the space within the rim, and these tubes are exactly parallel with a line drawn from the point "N," which indicates north, and "S," which indicates south. Between the two central tubes, and exactly in the center of the space, is a brass bulb in the bottom of which is a hollowed-out sapphire or some other equally hard stone, which rests on the point of the brass spindle. In the brass tubes that extend from one side of the rim to the other, are little steel wires which are the bar magnets, the soul of the compass. The copper bowl that contains the card, spindle and steel magnets, is filled with a liquid composed of distilled water and alcohol, and the top is covered with a piece of clear glass, so that the copper bulb is hermetically sealed.

The card thus not only rests on the brass spindle, but also partially floats on the liquid. This reduces the weight on the spindle to a minimum, holds the card steady, and serves to compensate for the "dip" when the vessel sails nearer the magnetic poles. The "lubber's point" is a mark made in the compass, which is in line with the keel of the vessel, and this point indicates the direction which the vessel is sailing. The man at the wheel is ordered to keep the ship on a certain course, say due "north." With his eye on the card, he brings the lubber's point and the point marked "N" on the card together, and when, by reason of the wind, wave, or tide, the lubber's point moves to one side or the other of "N," he gives the wheel a turn or two and brings the points together again.

THE NAUTICAL ALMANAC AND ITS IMPORTANCE

An essential adjunct to the various instruments used by navigators for the safe handling of ships at sea, is a volume called the Nautical Almanac or the American Astronomical Ephemeris. To a layman this is merely a dull and complicated collection of mathematical tables, but to the navigator it is a handbook of the highest value.

The business of the Nautical Almanac is to predict, one or more years in advance, astronomical phenomena, the actual occurrence of which is recorded at the observatory, for the use of seamen while on the otherwise pathless sea. The compass alone is not a sufficient guide for the navigator. It simply informs him in an imperfect and uncertain manner of the direction of the cardinal points, but does not give him the slightest information respecting his actual position. That can be found out only by consulting the heavenly bodies, and that the observation may be practical, the position of the heavenly bodies at that exact time must be known with a high degree of accuracy. Those positions are given in the Nautical Almanac, which is thus an absolute necessity for seamen.

The determination of longitudes at sea by the method known as the "lunar observations," the only method employed in the common practice of navigators where chronometers are wanting, or are untrustworthy, or require verification, depends essentially upon the accuracy of the moon's predicted place.

The superintendent of the Nautical Almanac is Professor Simon Newcomb, one of the most eminent scientists and astronomers in the world. He is assisted by various other computers, mathematicians and astronomers. Professor Newcomb outlined the development of the Nautical Almanac from the beginning of scientific navigation in an interesting interview.

"Although the theories of Ptolemy were founded on a false system," said Professor Newcomb, "they sufficed to predict the position of the sun, moon and planets with enough accuracy for the calculations of astrologers.

"The great Kepler was obliged to print an astrological almanac in virtue of his position as astronomer at the court of the king of Austria, but notwithstanding the popular belief that astronomy had its origin in astrology, the writings of astronomers proper in all ages show that they never had any belief in astrology. Kepler himself submitted to the humiliation of preparing this almanac only through pressure of poverty. Subsequent ephemerides, giving the longitudes of the planets, the position of the sun, the time of its rising and setting, the eclipses, etc., were issued by Kepler and his successors from time to time at irregular intervals. The earliest regular ephemerides, so far as I am aware, was the French Nautical Almanac, first issued in 1679 by Picard. It has been continued without interruption to the present time. The first issue of the British Nautical Almanac appeared in 1766, and the United States Government undertook the work for the benefit of our seamen in 1849 under the superintendence of the late Rear-Admiral Davis.

"There are signal advantages to be derived from the Nautical Almanac which concern the navigator, surveyor, astronomer, and geographer. One of them relates to the tides. The conduct of a general system of tidal observations, their deduction and their scientific discussion, by which are evolved the rules for the prediction of the tides, are all the property of the hydrographical and astronomical departments of the coast survey. But it is the province of the Nautical Almanac to present the results of these various labors in a manner suited to answer the practical demands of navigation and engineering. We were formerly indebted to observations and deductions made in France and Great Britain for the principal part of our knowledge of these interesting and important phenomena. The tide tables of the American Statistical Almanac and Repository, as well as those of the numerous other popular almanacs published in this country, which consist almost exclusively of the times of high and low water, are derived directly from the tide tables of the British Almanac, computed, of course, without any reference to our own coast and its peculiarities.

"But it will be readily perceived that if the results obtained by La Place on the east side of the channel are not applicable to the British shores and harbors, still less are those derived from observations made on the east side of the Atlantic likely to represent the real phenomena on the American coasts. In order to be able to give rules practically useful to the pilot, engineer and seaman for applying to the ordinary tides corrections depending on the moon's varying distance and declination, it is necessary to know to what meridian passage, or southing of the moon, the tide is due; or what is the distance from the land of the general tide-wave that causes the local tide which the observer is actually registering; or, in short, what is the age of the tide when it arrives at any particular part of our coast. That knowledge is the result of the careful study of a large number of observations made at various points. The age of the tide at London differs from that at Key West, and that at Key West, again, from that of New York or Hampton Roads.

"The Nautical Almanac, published annually, each number of which consists of between 500 and 600 pages, embraces all the elements necessary for determining at any time the absolute and relative places of the sun, moon and seven principal planets, and of many of the largest and most useful of the fixed stars, together with several different series of phenomena for the determination of longitudes, such as occultations of fixed stars and planets by the moon, the distances of the moon from the fixed stars and planets, the combined transits of the moon and certain fixed stars, eclipses and configurations of Jupiter's satellites, etc. To these are added the places of the minor planets and their elements, with rules and tables for practical use in nautical astronomy and land observations, new rules and methods whenever invented, tables of tides, and a chapter explaining the plan of work and the mode of applying its various parts in practice, in which is included some elementary scientific instruction.

"These details are the results of numerous laborious and complicated calculations. Strict and uniform accuracy is an indispensable requisite. In the case of the mariner, errors expose life and property to danger, and in that of the astronomer on the land they cause a waste of time and labor, and not seldom the irretrievable loss of valuable opportunities. None of the precautions, therefore, that experience has pointed out for the attainment of correctness and for security against mistake, is neglected.

"The Nautical Almanac is stamped by this circumstance with a peculiar character. Unfailing precision and exactness are the absolute conditions of its usefulness. But every person of experience knows that neither such extensive computations nor the printing of so many figures can be conducted with entire freedom from error, and to remedy this defect, inherent in such productions, the errors detected are printed and the corrections applied in subsequent volumes, probably before the first comes into general use.

"The calculations of the Nautical Almanac in reference to the sun, moon, and principal planets are, in the case of each one of them, based upon our own knowledge of their motions and the laws by which they are controlled, derived from the general theories of celestial mechanics, and from observations which, while they test the truth of the general theory, lead to the discovery of new facts and data, to the detection of other laws, and to the inference of new generalizations.

"The observations employed comprise all the calculations of good authority which, from age to age, have accumulated in the rich treasury of astronomical science, ending with the latest publications of existing observatories and going back to the beginning of authentic history. In order suitably to convey our knowledge of the laws governing the motions of the heavenly bodies, and regulating their more or less rapid change of place, and to put this knowledge in a form adapted to the wants and uses of the computer, numerical tables have to be prepared, of the sun and the planets separately, which constitute the abbreviated expressions of these laws.

"The numerical tables greatly facilitate the labor of computations. They are the computer's tools of trade. To construct the tables; to make, compile and arrange the observations; to discuss them; to discover and investigate the theories and laws, and to invent that kind of logic, the higher mathematics, by which alone such investigations can be profitably pursued and their results succinctly defined, have been the occupations in every enlightened age, of the most illustrious genius and the most exalted talents. And a correct and well-conducted astronomical ephemeris, which comes up to the latest standard of modern improvement and discovery, is to be regarded as the full exponent of all this human thought and labor.

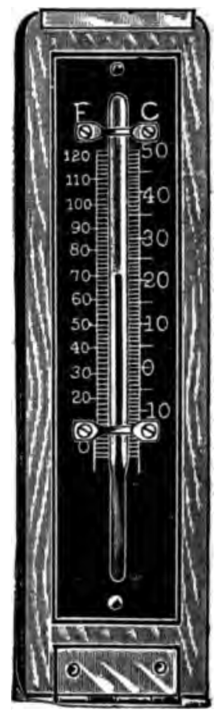
"The primary motive for computing and publishing the Nautical Almanac was to promulgate the lunar method for determining longitude at sea, and to furnish the requisite elements and precepts for the computation of this problem. This was as early as the year 1767. Its appearance created a new era in navigation, to which it is now acknowledged to have rendered more essential service than anything else ever undertaken.

"On the one hand it is a text-book of the navigator. It informs him of his place on the ocean, where there are no other guides than the sun and stars. It is his intellectual rudder and compass; without it no shipmaster leaves the shores of the United States. When he loses sight of the last lighthouse or headland he turns to that for his further direction. On the other hand it is the vade mecum of the astronomer, whether stationary or traveling. He learns from it in the fixed observatory how his instrument must be set that he may see any particular body, and what is the precise moment for observation; and in the movable observatory he turns to its pages to ascertain how, on any given day, he can best determine his latitude and longitude, the astronomical bearings of his stations, and the rate and error of his chronometer. Thus, as the tables of the almanac owe their origin to the labors of the observatories, so they repay the obligation by affording the most ready and complete facilities by which those labors are at the present time safely and expeditiously conducted."

THERMOMETERS AND THE MEASURES OF TEMPERATURE

The average thermometer is as unreliable as an April day. Its column of mercury may indicate the proper degree of temperature, and it may be 10 degrees off. This is because the average thermometer is a cheap thermometer; it is one of a batch made as cheaply as possible, to be sold at a low figure. A man who owned what he thought was a first-class thermometer because it was set in a ground glass frame, made a rash bet with a neighbor who had a good-looking thermometer hanging outside his window.

He bet that a comparison with a "standard" thermometer would show that his temperature indicator was correct within half a degree. The test was made and he was surprised to find that his pet thermometer had been telling lies every day for over a year. It was six degrees high.



Thermometer with Fahrenheit and Centigrade scales.

"That's a summer thermometer," said the dealer in scientific instruments. "It gives you good grounds for bragging that the temperature on a hot day is 100 in the shade." Then he loosened the metal scale, slipped it down six points and said:

"Now it is more nearly correct. It's close enough for you, but it would scarcely do for precise work where readings of one-hundredth of a degree are made."

In making a mercurial thermometer of the better grade a piece of hard glass tubing is selected. The bore is critically examined, for it must be narrow, and uniform in diameter from one end to the other. The bore may be perfectly round or elliptical, but whatever its shape it must not vary in its size.

The uniformity is ascertained by measuring a short column of mercury at different points in the tube. If the glass tube is acceptable the bulb, which serves as a reservoir for the mercury, is blown in one end. The bulb varies in form, size and thickness according to the purpose for which the thermometer is intended. It may be spherical, pear-shaped, oval, cylindrical or tubular. It sometimes is made apart from the stem and afterward is joined to it.

This method is preferred for making thermometers in which the nicest precision is required, for then the bulb having the right capacity can be selected.

The glass-blower who makes a specialty of thermometer bulbs pays close attention to the thickness of the walls of a bulb. If the glass is too thin the bulb will yield to atmospheric pressure and raise the zero point; if too thick, the bulb will not be sensitive enough to variations in temperature and the thermometer will be of little value.

When the bulb is properly blown and fixed to the end of the glass stem, a second bulb is blown a short distance from the other end. This second bulb comes into use when the mercury is put into the stem and bulb of the thermometer. This is done at the time the second bulb is made, for before the glass is half cooled, the open end is plunged into the mercury, which gradually rises in the tube. The tube is allowed to cool, and again is heated, more mercury is "sucked in," and so, by judicious heating and cooling, the lower bulb is filled.

A wire handle then is bent around the tube to hold it while it is heated over a suitable furnace until the mercury boils, -d boiling expels the air in the tube. The ι end of the tube is kept cooler than the stem and lower bulb, and while the mercury is boiling, some sealing wax is placed over the open end. This seals the tube and prevents the air from entering.

When the partly made thermometer is cooled, the quicksilver fills the tube and bulb below the upper bulb. The lower bulb is then heated until the mercury expands and runs into the upper bulb, and just as the column of mercury begins to go back in cooling the glassblower hermetically seals the tube just below the upper bulb, which is then drawn off. This leaves the mercury in a vacuum in the tube, and the thermometer is ready to be graduated.

This is not done immediately, however. It is stored for some time and heated for several days to 50 or 100 degrees above the temperature it is intended to indicate. There is a good reason for this, because if a thermometer is graduated soon after it is made the "zero" point rises in a short time, and is incorrect from ½ to 3 or more degrees. This is due to the imperfect elasticity of glass.

Glass when heated expands, but does not return to its former dimensions for some time after it is cold. In a few months after it has been filled a thermometer bulb shrinks. This shrinkage reduces its original capacity and, of course, squeezes the mercury up into the stem, causing the zero point—the basis of the graduation—to rise, and thus throwing the entire thermometer out of "true," as a mechanic would put it. For this reason the graduation is deferred until the glass has settled into a normal condition. When this period of probation is at an end the thermometer is ready to have its degrees marked on it.

Two points are fixed. The lower usually is taken first. It indicates the freezing point of water, and on the Fahrenheit scale, the one commonly used in the United States, is 32 degrees above zero. The higher point indicates the boiling point of water, and on the Fahrenheit scale is 212 degrees above zero. Water the world over freezes at the same temperature, hence it gives an accurate and easy standard for setting a mark from which to graduate thermometers. Water at the same altitude always boils practically at the same temperature, so that water, under two different conditions, can set the two marks on a thermometer. The freezing point is found by placing the thermometer vertically in finely pounded melting ice, contained in a vessel which permits the water to drain away. The whole of the mercurial column is plunged into the ice and kept there for half an hour. Then it is lifted just high enough to show the top of the mercury, and its position is marked, and that mark represents 32 on the scale. The temperature of boiling water is the higher fixed point. The thermometer is immersed in the steam of water boiling freely, and when the mercury refuses to rise higher the point is marked, and this point is 212 on the scale.

The space between the lower or freezing point and the upper or boiling point is divided into 180 degrees, and this division is carried below the freezing point 32 degrees to mark the zero point.

The centigrade scale is used largely in Europe and by chemists and scientists in America. In this scale the freezing point is zero and the boiling point is marked 100. The space between is divided into 100 degrees. In the notation employed for thermometer readings "C" is the abbreviation used for centigrade and "Fahr" for Fahrenheit. Reaumur thermometers, used in Germany, Russia, Holland and other parts of Europe, are graduated from 0, freezing point, to 80, boiling point. The centigrade system of graduation is becoming more popular every year. The countries which use it most are those which employ the metric system of weights and measures. Until we adopt the latter, we shall probably continue to measure our temperature by the less logical Fahrenheit scale.

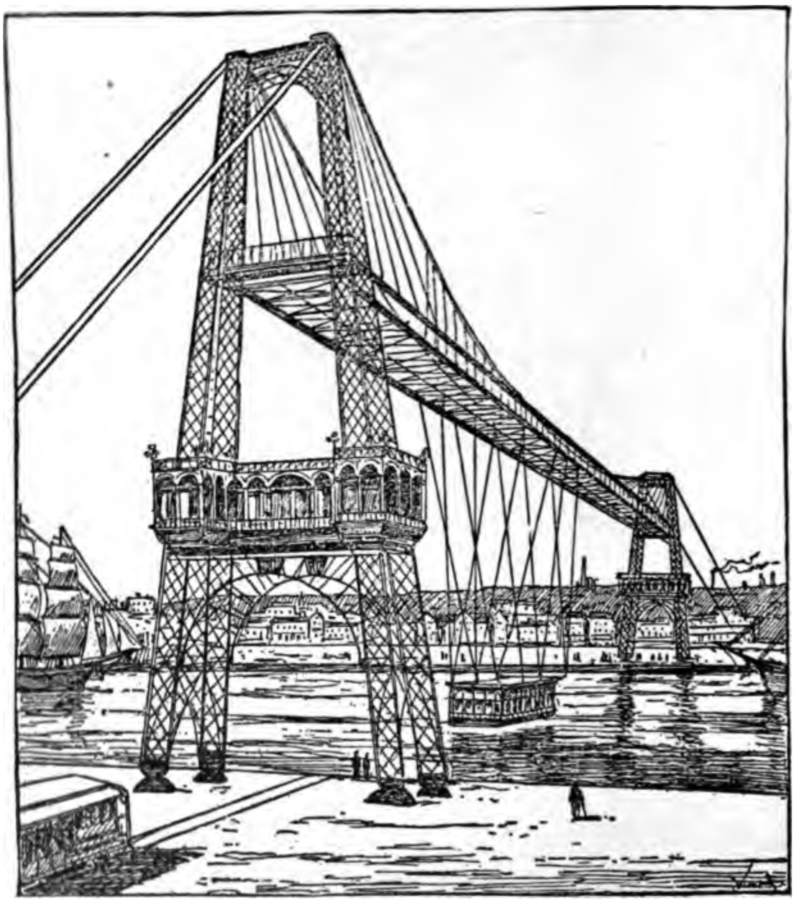
Some thermometers intended for use in very cold countries have determined on their scales a point much lower than any marked on ordinary thermometers. It is the freezing point of mercury, and mercury freezes at 40 degrees below zero. This low point is determined as follows:

From seventeen to twenty pounds of mercury are used for the freezing mixture, and it is first cooled down to about 10 degrees below zero. Carbon dioxide is a gas which is capable of being liquefied under great pressure. When this liquid is permitted to expand freely into gas again it forms artificial snow, intensely cold. To freeze the mercury, liquid carbon dioxide is used. The gas is allowed to escape for about a minute, during which time about 550 grains of solid carbon dioxide are deposited in the form of snow. This is laid on the surface of the mercury, together with some ether. When it is all mixed together, the liberated gas and ether vapor, escaping through the mercury, cool it down and cause it to solidify on the surface, which is then stirred in. This causes the mercury to become pasty, and then the thermometer is plunged into the frozen quicksilver, and thus the point of freezing mercury is determined. For low temperatures alcohol is most suitable, as it does not become solid until —130.5 degrees is reached.

ROUEN'S AIR FERRY, ODDEST OF BRIDGES

Rivers have played an important part in the development of civilization. They have been the highways of communication by which mankind has explored the world, extended settlement and transported products, long before railways began in part to supplant them in importance. At the mouths of the rivers grew the ports where commerce interchanged between sea and land, and so the world's greatest cities in large degree have been dependent upon these paths of nature for their prosperity.

Not to be hemmed in and limited by the rivers which served them so well, men early had to devise some means of crossing them regularly, rapidly and safely. So the very beginnings of civil engineering may be found in this necessity of establishing some way of crossing rivers. Among the means which the engineer has hitherto employed to cross rivers and channels are boats or ordinary ferries, swing, draw, bascule and ordinary bridges, tunnels under the beds of channels and traveling carriers.



FERRY ACROSS THE RIVER SEINE AT ROUEN, FRANCE.

The "Pont Transbordeur," or overhead ferry, which has been built and is now in successful operation over the River Seine, at Rouen, France, represents the solution in a novel way of one of the most interesting problems in engineering. There is nothing like this overhead ferry in any other country in the world.

The swing, draw and bascule bridges can be safely used only over locks, inland canals or rivers, where a vessel can be under perfect control in all kinds of weather. Ordinary bridges are more satisfactory than the others, but if they are to cross a river leading to an important harbor they should be of a height to permit a ship with the tallest mast to pass under. Some masts are 200 feet above the water. Inclines or elevators must be used to reach the bridge level, and the reason that there are so few bridges like the Forth Bridge in Scotland and the Brooklyn Bridge is their great cost. The objection to tunnels is the great cost and risk in building. Many large tunnels under water have been abandoned, and even when built they are not greatly appreciated by the general public.

The overhead ferry system remedies all these drawbacks. The advantages of the system are: The channel to be crossed is left entirely clear at all hours, without requiring vessels to make any special signals or modify their rate of speed any more than they would in the case of a cross-channel ferry. No increase of distance or ascent or descent is forced on the traffic in order to cross from one shore to the other.

The essential part of the system may be described as a horizontal railway supported by a bridge spanning the channel and built up at such a height as will allow the tallest masted vessels frequenting the channel to pass beneath.

The platform of the bridge carries two lines of rails, over which a carriage on small wheels rolls, the number of wheels varying with the weight to be carried. The rollers are connected with a movable frame under the line of rails, which may freely move in a longitudinal direction quite close to the platform and from one end to the other of same. Thus is provided a rudimentary vehicle which can cross the channel without interfering in any way with the opening which is to remain clear.

In order to obviate any swinging motion which might result from the pressure of the wind or the forward motion of the carrier itself, the rods by which the latter is suspended are arranged in triangles, both in the longitudinal and transversal directions. There is thus a little railway for crossing the river, with this difference, that the body of the vehicle, instead of being above the rails and wheels as usual, is some 140 or 160 feet below these. All day and all night this peculiar car travels back and forth across the Seine, proving its efficiency by handling a large traffic without delay or accident.

The Rouen bridge ferry offers an interesting contrast to the tower bridge of London, the elevator bridge of Chicago, and the great Brooklyn bridge, all of which are pictured in this volume.

Siberia is traversed by a great number of large rivers, and travel through the sparsely settled country has not been sufficient to warrant the construction of costly bridges, nor yet to maintain expensive power ferries. These conditions have established a novel and cheap form of ferry which is commonly found in that great northern land. The ferry boat to be utilized is anchored in the middle of the river by a cable about three times as long as the width of the stream from bank to bank. The boat, of course, swings with the current down stream from the place of anchorage. By merely steering with the rudder, the ingenious boatmen make use of the current itself to drive their craft to one shore or the other, back and forth at will, on the arc of a great circle. A landing at either side is prepared, and they are ready for business, with true economy of power. For several months in the year these rivers are closed by ice, when sleds supplant the ferries, which await the return of summer.

IRRIGATION METHODS IN AN OASIS IN THE SAHARA DESERT.

Water is life in the desert to a degree that we do not realize in our more favored land. This crude machine, turned by camel power, raises water from the little stream to the irrigation ditches, which distribute it among the fields which produce the most luscious of fruits and the other crops on which the desert tribes live.

BOOK III

Marvelous Peculiarities and Noteworthy Facts of all Nations and Countries of the World

SETTLEMENTS AND MIGRATIONS OF NATIONALITIES IN THE UNITED STATES

"From whence came we?" may not be so interesting to us as, "whither do we go?" but it offers some curious facts as to "who are we?"

At the close of the Revolutionary War, there were probably but little more than three million persons composing the new nation. It is estimated that from the Declaration of Independence until the census in 1820, there were not more than 250,000 immigrants, although there were enrolled at that time a total population of

THE AMERICAN LIBERTY BELL, LEAVING PHILADELPHIA FOR A GREAT EXPOSITION.

9,638,453. From that census up to 1902, there came into the United States a little more than 21,000,000 immigrants, from nearly a hundred different nations, thus, with the natural increase, bringing the population up to nearly eighty millions in 1902.

The colored race in the United States, being free from addition by immigration, except in the time previous to 1800, shows a remarkable ratio in the increase by birth, notwithstanding the fact that their death rate is estimated to be much greater than that of the white people.

In 1790 there were 757,208 colored persons in the United States; in 1840, 2,873,648; in 1890, 7,470,040, and in 1902, an estimated number of about 9,000,000. They were first brought as slaves, 20 in number, to Jamestown, Virginia, in 1619. In 1624 there were but 24 in the colonies; in 1648 there were 300. Then their service as tobacco raisers caused them to be imported in great numbers.

Although the Spaniards made permanent settlements at St. Augustine in 1565, at Santa Fe in 1581, and at New Orleans in 1763, they never increased in numbers and so have made little impression on the general civilization of the country.

The English began their settlement at Jamestown, Virginia, in 1607, but during the rule of Cromwell, the cavaliers or adherents of the Stuarts, came over in such numbers that their character was given to the social and political nature of the whole population. The descendants of these people moved west and their spirit dominated the western belt, covering Kentucky and Tennessee.

Under the persecutions of the Stuarts, *the Puritans* to the number of about 21,000 came to America, spreading from the first settlement made by them at Plymouth, in 1620, among numerous branches. The descendants of these likewise moved west, and it is estimated that at least 13,000,000 residents of the north trace their ancestry to those sources.

The French came from Canada to the Mississippi Valley and finally made a permanent settlement at Saint Louis in 1764. They had come already, in 1718, in considerable numbers from the French West Indies to New Orleans. They have had no perceptible migrations, but their influence along the track of their first settlements has been widely felt.

The English Catholics came to St. Mary's in Maryland, in 1634, and their line of migration can be distinctly traced along the Ohio Valley, but they chiefly populated the surrounding region.

The English Quakers came to Philadelphia in 1683 and their influence was for nearly two centuries dominant throughout Pennsylvania.

The English debtors and paupers who were taken to Savannah in 1733 went westward and settled the interior portions of Georgia and Alabama, the line extending on through into Arkansas and Missouri.

The Dutch settled the present site of New York City in 1613. Not having a migrating character, they remained to become the chief social and commercial factors of the metropolis. Three presidents of the United States are of that ancestry. Some of the poorer classes moved westward into Pennsylvania where they still retain many of their old customs.

The Germans made their first settlement at Germantown, near Philadelphia, in 1683. The ground was bought from William Penn by Jacob Telner of Crefeld, a town on the lower Rhine near the boundary line of Holland. They were members of the sect known as Mennonites. Since then the immigration from Germany has exceeded that of any other nation.

The Hebrews came first to New York in 1654, from Brazil, twenty-seven in number. Their baggage was seized on landing to pay their passage, and this not being sufficient, two of their number were seized and imprisoned till the remainder was paid. On July 7, 1733, while Governor Oglethorpe and his colonists were assembled at a public dinner on the present site of Savannah, forty Hebrews from London sailed up the river, landed there and proceeded to make themselves at home. It created a sensation, both among the colonists and the London owners of the land, but Oglethorpe was their friend and they remained to become the most influential citizens of the South Atlantic seaboard.

In 1638 the Swedes formed a settlement on the Delaware River, but were compelled to give up their charter to the land, between the encroachments of the Dutch and the claims of the Quakers.

Italians, Chinese and other immigrants who did not come to make this country their home, nowhere have become fixtures as citizens or influential factors in civilization, except in isolated instances.

The Norwegians were among the latest of the permanent additions to the population of the country.

The Albany Patriot of October 24, 1825, contained the following news item: "On Saturday, as we are informed, the Norwegian emigrants that lately arrived in a small vessel at New York, passed through this city, on their way to their place of destination. They appear to be quite pleased with what they see in this country, if we may judge from their good humored countenances. Success attend their efforts in this asylum of the oppressed."

These fifty persons were the first Norwegians to settle in the United States, and their destination was Murray, now Kendall, in Orleans County, New York. Their line of migration was southwest, reaching as far as Central Illinois, with a few families in Kansas and Missouri. In later years they have settled in the states of the upper Mississippi valley.

The Irish immigration began with the revolution and was without record, previous to the census of 1820. It was confined almost wholly to the cities, of which New York was the center. No other nationality has had such a large share of influence on the politics of the Nation.

According to the census of 1900, the principal foreign-born population of the United States was as follows: Germans, 2,600,000; Irish, 1,780,000; British, 1,245,000; Scandinavians, 1,040,000; Russians and Poles, 700,000, and other miscellaneous nationalities to the total of 10,-160,000.

GREATEST FACTS IN THE HISTORY OF THE UNITED STATES

Types of civilization in first settlements:

The French at St. Louis, Feb. 15, 1764, at New Orleans in 1718.

The Spaniards at St. Augustine, in 1565, and at New Orleans in 1763.

The English cavaliers at Jamestown in the settlement made in 1607.

The English Puritans at Plymouth in 1620.

migration where possible. Chinese immigration was altogether forbidden, and certain restrictions were adopted to safeguard the nation from improper European immigrants.

It must be admitted, however, that in spite of legislation forbidding the importation of laborers under contract and the exaction of certain standards of health, intelligence, and money from the immigrants seeking admission, the conditions have not greatly improved. The influx of immigrants from Hungary, Italy and Russia of late years, has been enormous, while there has been a gradual reduction in the numbers from Germany, Scandinavia and the British Isles, or the more desirable elements of population. Of course, it is to be expected that Hungarians, Italians and Russian Jews will develop into good American citizens at least in the second generation here, if not in the first. But they come to this country with but faint realization of the ideals and aspirations of Americans and little prepared for the liberty which rules here. They do not assimilate with the American and the Northern European elements of our population, nor do they scatter into the country, but, forming their own communities in our great cities, they help to add to the puzzling problems which face our students of municipal life.

The greatest number of immigrants reaching the shores of America enters by way of the port of New York. The first conspicuous object which greets them and for which they have been looking all the way across the Atlantic, for it is famed throughout Europe, is the great Bartholdi statue of "Liberty Enlightening the World," that splendid emblematic figure which rises from a little island in New York harbor to welcome the stranger. Most of the immigrants know something of the significance of the statue and it rarely fails to impress them.

This famous statue was designed by Bartholdi, a great French sculptor, and was given to the people of the United States by the people of France. The site on Bedlo's Island was set aside for it by the United States government, and the pedestal was erected by funds given by contributors from all over the United States. The statue is made of thin sheets of copper beaten into shape and fastened about an iron skeleton. The figure of the statue itself is 110½ feet high and weighs 100,000 pounds. The uplifted torch extends this height twenty-six feet more, and adding to this the pedestal, the tip of the torch is elevated 220 feet from the ground. The pedestal is of stone, eighty-two feet high. Some idea of the enormous proportions of the statue may be given from the fact that the forefinger is eight feet long and four feet in circumference at the second joint. The head is fourteen feet high, and forty persons can stand in it. The observation balcony around the torch, just below the flame, is a favorite viewpoint for travelers who wish to see the whole of New York City, with large portions of Long Island, the New Jersey coast, and New York harbor spread out before them in one splendid panorama.

Closely associated with the idea of liberty itself, is that splendid relic now considered our chief emblem of independence, the old Liberty Bell of Pennsylvania. The order for the bell was given in 1751. The State House of Pennsylvania, in Philadelphia, work on which had been suspended for a number of years, was then approach-

RUSSIAN IMMIGRANTS, "THE DOUKHOBARS."

ing completion. A committee was appointed to have a new bell cast for the building, and the contract was awarded to a London manufacturer, the specification being that the bell should weigh 2,000 pounds and cost £100.

In August, 1752, the bell arrived, but though in apparent good order, it was cracked by a stroke of the clapper while being tested. The bell was recast, and the new bell was found to be defective also. Once again there was a recasting of the metal, with the alloy of copper in a new proportion, and this third effort was a success.

It was on Monday, the 8th of July, 1776 (not the 4th), that the bell rang out the memorable message of liberty and signaled the promulgation of the Declaration of Independence. It seemed strikingly prophetic that the bell should have been cast with the motto, "Proclaim liberty throughout all the land, unto all the inhabitants thereof." For fifty years the bell continued to be rung on every festival and anniversary, until it eventually cracked in July, 1835, when it was tolling for the death of Chief Justice John Marshall.

Since that time the bell has been one of the chief attractions to Americans visiting Philadelphia, and its place in the State House has been a shrine for patriots. Of late years the bell has been a conspicuous attraction at the various great expositions held in the United States. Wherever it has been taken, to Chicago, Omaha, Nashville, Buffalo, Charleston or elsewhere, its journey has been a triumphal progress, and thousands of interested citizens have turned out along the way to watch its train in passing. Significant as it is, as a memorial of those colonial days when our forefathers were struggling for independence, this Liberty Bell and the Statue of Liberty seem linked together through the century by a common significance.

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IMMIGRATION STATISTICS

The latest statistics of immigrants into the United States from all the world since 1867 are given herewith. It is interesting to note the periods of fluctuation that mark the successive years. The increase from the end of the Civil War to the panic of 1873 was large and almost uninterrupted. Then came a rapid decrease, and until the return of striking prosperity in 1880, the numbers were comparatively small. The next few years showed enormous immigration, with 1882 as the highest watermark. Again, however, there was a steady decrease for a few years, although the tide turned in 1887. When our last panic came, in 1893, it cut down immigration very rapidly, and since that time, coincident with a more exacting administration of the immigration laws, the numbers have never again approached their highest point, although since 1898 there has been an annual increase. The figures for the years indicated follow herewith. It should be understood that the calculations are made at the close of each fiscal year, which ends with June 30.

1867	298,967
1868	282,189
1869	352,569
1870	387,203
1871	321,350
1872	404,806
1873	459,803
1874	313,339
1875	227,498
1876	169,986
1877	141,857
1878	138,469
1879	177,826
1880	457,257
1881	669,431
1882	788,992
1883	603,322
1884	518,592
1885	395,346
1886	334,203
1887	490,109
1888	546,889
1889	444,427
1890	455,302
1891	560,319
1892	623,084
1893	502,917
1894	285,631
1895	258,536
1896	343,267
1897	230,832
1898	229,299
1899	311,715
1900	448,572
1901	487,918

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OUR AMERICAN ARCHIVES AND NATIONAL INSTITUTIONS

That which might be known as the archive of American relics is the Smithsonian Institution or National Museum at Washington. It attained its present form when, in 1881, the building now occupied was completed for the national relics that had been transferred from the Centennial Exposition and the old buildings of the Smithsonian Institution. Although the relics of the Museum and the Institution are housed together, and are under the same management, they are separate organizations. So, with the ten million dollars given to the government by Andrew Carnegie for the establishment of a university of post-graduate scientific investigation, the three will be made to work together in harmony, which, with the nearness of the great

Congressional Library, and the many bureaus of the government, such as the Fish Commission, Geological, Coast, and Geodetic surveys, the Naval Observatory, and the Weather, Botanical, Biological and Entomological Bureaus, will together make the greatest post-graduate university in the world.

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POPULATION AREAS OF THE UNITED STATES

America's "seat of empire" is found in the prairie region of the Central West, of which Chicago is the commercial metropolis. The flat or undulating prairie, in its natural state almost bare of trees, but covered with luxuriant grasses, now constitutes the topographic division of the United States which contains the greatest population. The prairie as the home of American citizens has outstripped all competitors. Neither the populous New England hills nor the great Atlantic coast plain, with its large cities and many thriving towns, nor yet the vast interior timbered region with all its wealth and opportunity, has kept pace with the beautiful prairie of the West.

According to the geographers of the census bureau, continental United States is divided into nineteen regions, each having somewhat uniform physiographic features. The population of these regions and their percentage of the whole population of the United States is as follows:

	Population.	Pct.
Prairie region..........	13,300,970	17.5
New England hills (includes New York City and a strip of eastern New York State, also the Adirondacks).....	10,260,153	13.5
Lake region...........	9,571,215	12.6
Interior timbered region.	8,129,760	10.7
Piedmont region.......	6,809,103	9.0
Coastal plain (east of Mississippi river)....	6,427,635	8.4
Allegheny plateau......	6,070,246	8.0
Appalachian valley.....	4,499,072	5.9
Coastal plain (west of Mississippi river)....	1,974,677	2.6
Coast lowlands.........	1,865,952	2.4
Mississippi alluvial region	1,227,094	1.6
Ozark hills............	1,203,880	1.6
Coast ranges...........	1,079,992	1.4
Great plains...........	1,052,719	1.4
Pacific valley..........	995,363	1.3
Rocky mountain........	592,972	0.8
Great basin...........	375,345	0.5
Columbian mesas.......	356,758	0.5
Plateau region.........	201,669	0.3

POPULATION AREAS OF THE UNITED STATES.

It is the theory of scientific statisticians that geographic differences exert a profound influence upon the people subject to them. They contend, therefore, that a division of the country into well-marked natural regions affords a better basis for classification of the population of the United States than the political lines often arbitrarily run. Nature, not man, fits a country for population, and the population will be great or small according to the advantages or disadvantages which nature herself has prescribed. Geology, topography, altitude, rainfall, temperature and soil—these are the determining factors. Thus dividing the United States into natural rather than into political regions, it certainly is a noteworthy fact that at the beginning of the new century the prairie region stands first in the list.

More than one-sixth of the whole population of the continental United States lives upon the prairie. The people of the prairie equal one-third of the population of France. They are as many as the people of Germany, leaving out Prussia and Bavaria. They equal one-half of the population of England and Wales. They almost exactly duplicate, in number, the entire population of Mexico, and are but a little short of the total number in Spain. They outnumber the combined populations of Belgium and Holland.

TAXIDERMIST AT WORK.

Strictly speaking, Chicago is not itself in the prairie region. According to the geographers of the census, the great western metropolis stands within the lake region, a few miles from the line where the mighty prairies begin their stretch toward the west and south. This lake region is third in the list of great topographical divisions of the United States, and the two areas which lie on either side of Chicago contain together a population of nearly 23,000,000, or 30 per cent of the entire population of the United States. If to these two be added the interior timbered region lying near to Chicago on the southeast, and embracing most of Indiana, Ohio and Kentucky, and small parts of Illinois, Tennessee and Missouri, it will be found that the three regions adjacent and tributary to Chicago comprise more than two-fifths of the people of the United States.

It is worthy of note that the second most populous topographical region, the New England hills, is the section which gave blood and bone and sinew and spirit to the prairie and the other areas of the farther West. The "star of empire" has taken its way from these hills to the timbered country beyond the mountains, to the borders of the great lakes, to the mighty prairie. There is a homogeneousness between the people of all four of these natural divisions of the continent which cannot be found between any other populous areas; and these four together furnish homes for 54 per cent of the people of the United States.

FACTS ABOUT OUR POSTAL SERVICE

Uncle Sam has many functions to perform in his capacity of governing a great country. With his army, he is a policeman; with his treasury department, he is a banker; with his agricultural department, he is a farmer; and with his mail service, he is a postman, to say nothing of a great many other functions of governing which might be named. In his capacity as a postman, Uncle Sam's mail routes now include the delivery of letters to the Philippines, to the West Indies, and to Alaska, as well as all over the United States. Perhaps most difficult of all these mail routes, although not the longest, is that by which the miners and whalers in northernmost Alaska have their mail brought to them in winter. The Hudson's Bay Company for

AT WORK IN THE CENSUS BUREAU.

more than 100 years has been maintaining communication through the trackless wastes of western and northern British America, from trading post to trading post, all the way from Hudson's Bay to the Mackenzie River, and far up into the Arctic Circle. But not until the discovery of gold in the hidden treasure houses of Alaska and the Canadian northwest, at Dawson City and Nome and points even more remote, did Uncle Sam's postmen have to assume such labor.

It was early in the spring of 1901 that the first carriers were sent to the farthest northern part of Alaska with the United States mail. Two men assumed the dangers of the journey a thousand miles over the ice fields, Francis H. Gambell and W. S. Flanagan. Their course was from St. Michaels to Kotzebue, returning by Cape Prince of Wales, Port Clarence, Teller, Nome, Golovin Bay and Norton Bay. They took with them but one sled, built of light birch and drawn by six Alaskan dogs. Their load included the mail, deer-skin sleeping-sacks, a shot-gun, snow-shoes, cooking utensils, a stove and other supplies, and their food itself, a total load of more than 350 pounds, which would, of course, be lessened day by day.

They started on a bright day with the thermometer four degrees below zero, but were not lucky enough to find it so warm all the way. Sometimes it was sixty degrees below zero, with a blizzard blowing, in which event they had to seek such shelter as they could get under the snow or otherwise. Sometimes they had to flounder through soft snow and pack down a trail with their snow-shoes, so that the dogs and sled would not sink down into it. At other times they had a glazed surface of ice or snow-crust and under these conditions traveling was easier.

Although Alaska is by no means a settled country, still it is not as lonesome as it was a few years ago, before the rush to the gold fields began. So sometimes the weary, half-frozen postmen would come to a little hut half buried in the snow, inhabited by Eskimos in some cases and at other times entirely deserted. Whatever the shelter, it was welcome. Frozen ptarmigan could be bought from the Eskimos for dog food, and the warmth of the hut was always grateful. Sometimes it was absolutely impossible to have a warm meal, even in one of the deserted huts. Mr. Gambell tells of one evening when he fed the dogs on frozen salmon and frozen bacon and crawled into his sleeping sack, dressed as he had been on the trail, to eat his supper with his hood and mittens on. His tea got cold before he could drink it, the beans seemed never to have been warmed up, the fork froze to his lips, and the biscuits and doughnuts were so hard that he first cut them up with his ax, so that he might be able to eat them. But in the end his appetite was satisfied and he drew the fur hood of the warm sleeping-sack over him and retired to rest.

At one of the native villages where they were hospitably received and given shelter by the Eskimos, they found the air in the hut so empty of oxygen that a coal-oil stove would not burn. The room was heated with seal-oil lamps, and the heat from the bodies of the human beings and dogs. Before going to bed, the master of the house closed up the only opening. There were fourteen people and two young dogs in that one small room, while the odor from the seal-oil added to the stifling closeness of the air. A few days later the postmen reached

Nome, which was the last station on their great circuit, and there they found what seemed genuine civilization again, with town life going on after the American fashion, in spite of the remoteness of the place. The mails were coming in by way of Dawson City once a week, being carried 2,000 miles by dog-team, and only two months old from home. These are the most remote and the most difficult mail routes which Uncle Sam's postmen have to travel, and they offer another indication of the remarkable ramifications of the services which a great government performs for its citizens.

The United States postal service is the greatest of its kind in the world. It spends more money, employs more men, and interests more people than any other institution ever established. In round numbers there are 75,000 postoffices and 250,000 employes. It handles annually ten billion pieces of mail matter, of which three billion are letters. We spend on the service as much every five hours now as in an entire year of Washington's administration.

Nearly 25,000 letters a day go astray from careless addressing, and the valuables in them amount to more than a million dol-

CASES OF HIGHLY CONDENSED PROVISIONS, READY FOR SHIPMENT TO THE FAR NORTH.

lars a year. The auditing department is the largest accounting office in the world. Every cent is there accounted for and it requires more than five hundred clerks to do it.

This is regarded as the most efficient government service of such proportions in the world and would be profitable except for the thousands of tons of mail matter handled as second-class mail matter at one cent a pound. This includes all classes of serial publications, but by a ruling of the assistant postmaster general a vast quantity of this matter has been excluded, such as paper-covered books and so-called newspapers and magazines that secure their circulation, not by merit, but by the premiums given. The carriers and clerks of the post-office have longer hours of labor and more exacting work than any other extensive branch of the service.

PEARY AND THE NORTH POLE

The conquest of the far north has been the object of the energies of explorers for many a year, and more than one of the greatest names in geography have gained their fame in this field of discovery. In late years there has been no cessation of the effort to reach the North Pole, and no year passes without the departure of some conspicuous expedition on that quest. Franklin, Kane and Greeley have been followed by Andree, Nansen and Peary, whose names are to-day those best known in Arctic exploration, the first for his disastrous balloon journey from which no one has returned; the second for his achievement of the farthest north; and the third, our own American explorer, for his persistence in his campaign against the pole.

Year after year, Lieutenant Robert E. Peary has renewed his assaults upon the land of ice and snow, each time accomplishing more in the discovery of important geographical and scientific facts, and each time coming nearer to the goal of his ambition. In this year of 1902 Lieutenant Peary is making his last attempt to reach the North Pole, for his wife has his promise that he will not go again. Already he has led four expeditions and has made seven voyages into the Arctic Seas. He has had his share of suffering and reverses, but unlike most polar explorers, who lose their enthusiasm after a voyage or two, he persists in the cause to which he has given the best years of his life.

A glimpse at the early history of Peary will help to indicate the character of the man who has fought so courageously for this prize. He was born in Pennsylvania in 1856, but passed his boyhood and youth in Maine, developing a love of outdoor life. He was educated at Bowdoin College, where he ranked high as a scholar and as an athlete. When he was twenty-three years old, he entered the service of the United States Government in the Coast and Geodetic Survey at Washington, and after two years passed examination and was appointed a civil engineer in the Navy Department. In the first year of his service he planned and built a new pier at Key West, Florida, which the contractors had given up as impossible of construction at the estimated cost, at a saving of nearly $30,000 below the estimate. Next he was sent to Nicaragua as one of the chiefs of the canal survey and it was after that, when he returned to Washington in 1885, that the idea of Arctic exploration occurred to him.

He made his first journey to Greenland

in 1886, and then spent two years again on the survey of the Nicaragua Canal. In 1891 he prepared to discover the northern limits of Greenland, and obtaining some contributions from societies and friends, he added all his own savings and set sail northward. At the very beginning of the journey, his leg was broken by an accident on shipboard, but he refused to return home, and spending the winter in Greenland, the next spring he set off with a single companion. In forty days they covered over 600 miles, reaching on the 4th of July the northern end of Greenland, which no man ever had seen before.

By his indomitable energy Lieutenant Peary obtained the funds, equipment, and an additional leave of absence for another journey. His chief source of income was his remarkable lecture tour, which earned him $13,000 in three months. In 1893 this expedition sailed, Mrs. Peary accompanying her husband to the far north. It was at these Greenland winter quarters that little Anighito, the "snow baby," was born to Lieutenant and Mrs. Peary. The next summer's journey into Greenland brought so many perils, hardships and disappointments that the explorer thought his Arctic work was finished. He soon discovered, however, that he could not be contented in comfort at home, while his plans for reaching the Pole were still untested. In 1896 and 1897 he made shorter voyages into the Arctic regions, and finally completed his plans for the extreme test.

By this time his untiring energy had won him a host of rich and influential friends at home, and they were making the preliminaries easy for him. Supplies, money and vessels were no longer out of reach, and in the summer of 1899 Peary sailed to the north for the seventh time. where he has been ever since. The intervening winters have been devoted to preparing the way for his dash to the Pole. He has established supply stations of provisions at intervals all the way along Smith Sound, Kennedy Channel and Robeson Channel, to Cape Hecla, the place of departure across the ice of Lincoln Sea toward the Pole. Cape Sabine, where Peary camped for the winter of 1901 and 1902, is famed in Arctic exploration as the place where nearly all the members of the Greeley expedition perished by starvation and cold twenty years before.

The camp was within a mile of that disastrous camp from which the few survivors were rescued by Admiral Schley, then captain, as a result of his own indomitable bravery and energy.

The prospect of success before Lieutenant Peary comes from the fact that he has gained the most exhaustive experience that anyone has to-day in the field of Arctic exploration. In the Arctic he lives as an Eskimo and speaks as an Eskimo, knowing as well as they how to drive dog teams, throw harpoons, and subsist upon frozen walrus and seal meat. Taught by the experience of the past, he established these supply stations so that when he should leave the last one of them behind, to begin his hasty journey to the Pole, he would be but 500 miles distant from that goal. The announced plans for this dash indicated that the explorer would take with him a large number of dogs, a party of Eskimos, and as a companion, Matt Henson, his faithful body servant, who has been his companion for years.

It was supposed that the distance to be passed between Cape Hecla and the Pole extended over every settlement, schools and churches have followed, until frontier and Arctic hardships have almost wholly given way to the comforts of civilization.

GREAT FUR-TRADING COMPANIES OF CANADA

Far away from the strife of contending political parties, and little visited by outside affairs in the winter, sleeps under its coat of snow the vast kingdom of the fur-traders. Overhead is the dazzling brightness of a northern sky, which at night is covered to the very zenith with dancing auroras. In summer, for two, three, or more months, the streams are unbound, a luxuriant vegetation bursts forth, and the summer green is as intense as the wintry whiteness has been.

Here the fur-trader must remain king. Mink and beaver, marten and otter, wolves, foxes and bears are his subjects, and, as in the case of all autocrats, the subjects exist for the profit of the ruler.

Perhaps one-quarter of North America will always remain the fur-traders' preserve. If a line be drawn from Moose Factory, at the foot of Hudson's Bay, to Norway House, at the northern end of Lake Winnipeg, thence to Fort Resolution on the Great Slave Lake, and westward to the Stikeen River on the Pacific Ocean, the boundary of a region will be marked, to the north of which is the fur-traders' kingdom, which likewise includes the whole Labrador peninsula east of Hudson's Bay. It is true this fur-traders' line has for two centuries been moving northward. Time was when the region of the Great Lakes, from Ontario to Superior and Michigan, was the home of the trader. It was

TRAPPERS AT WORK IN THE FAR NORTH.

for the fur of this large area that the early governors of New France and New York plotted and fought. So, later on, Rupert's Land, as the Arctic region of the north was called, was kept by the Hudson's Bay Company closed under fur-trading conditions.

Through the opening up of this region by the Dominion of Canada, the fur-line was moved north four or five hundred miles. Perhaps from the physical condition of the country, as unsuited to agriculture and possessed of a severe climate, the region north of the line traced above may always remain undisturbed to the fur-trader. Of this, however, no one can speak certainly, for the same declaration was made of New York, then of Canada, and later still of Rupert's Land.

There is a strange fascination about the life of the fur-trader. Placed in charge of an inland fort, surrounded and ministered to by an inferior race, and the leader of a small band of employes, his decisions must be final, and his word taken as law. As a monarch of his solitude he has great responsibility. His supply of goods must be obtained. There are places in the Yukon region where, hardly more than a decade ago, nine years were required from the time goods left London, until news of their receipt reached the shippers in London. It required wisdom and foresight to manage a post so remote.

In the busy season scores of Indians, squaws, and children may be seen in groups seated on the ground in the midst of the fort, their encampment being a group of tents, bark or skin, outside the stockade.

Washington Irving, in 1818, described, in "Astoria," the picturesque and somewhat hilarious life of the fur-trader in the Nor'wester capital of Montreal. Factors, traders, and voyageurs reveled in their liberty till the advance of the season compelled the voyage to be again undertaken. They sang at Ste. Anne, as they entered the Ottawa River, "their parting hymn," prayers were said to the patron saint of the voyageurs, the priest's blessing was received, and they hied away to face the rapid, décharge, or portage of their difficult route. When Fort William, on Thunder Bay, Lake Superior, was reached, they turned over their merchandise to new relays of men.

Scattered throughout the whole fur-trader's territory will be found the half-breed of French-Canadian or Orkney origin. Some beautiful lake or sheltered bend in the river, or the vicinity of a trader's post, has been selected by him as his home, and partly as an agriculturist or gardener, but far more a hunter or trapper, he rears his dusky race. Sometimes, when the engagé had served his score or two of years for the company, he retired with his Indian spouse and swarthy children to float down the streams to the older settlements, to what has been called "the paradise of Red River," and there, building his cabin on land allotted by the fur company, spent his remaining days.

Whatever may be said of its influence on the white man, the fur-trade has been a chief means in cementing the alliance between the white and red man. The half-breeds are a connecting link between the superior and the inferior race.

For many years it was the inflexible regulation of the Hudson's Bay Company to allow no half-breed to become an officer, but the rule could not be maintained, and on account of the Hudson's Bay Company having always assisted in the education and

Christianization of the native people, many of them have risen to high places in the fur-trade, as well as in other spheres of life.

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THE WALLED CITY OF THE NORTH

"Quel bec!" (what a promontory) cried a Norman captain as he stood on the deck of his vessel and looked at the great wall of rock which lined the bank of the St. Lawrence.

The Latin nations of Europe have always been very fond of giving nick-names to places newly discovered, especially if derived from some first impression of the scene, so "Quel bec," became Quebec, and has so remained ever since. Quebec, because of its isolated position, has kept its ways with but little regard to the changes of modern civilization. It is the American Gibraltar, and, perhaps, could never have been taken by Wolfe if Montcalm had not heroically scorned to fight behind stone

ICE JAM ON THE ST. LAWRENCE RIVER AT MONTREAL.

CANADIAN BOATMEN IN THE RAPIDS OF THE ST. LAWRENCE RIVER.

walls. Montcalm is buried in the Ursuline Church founded in 1639.

It is noted for the ancient beauty and venerable architecture of its chapels and churches. Here French and English in peculiar harmony, considering racial prejudices and differences in customs, labor and live side by side. Modern conveniences and scientific improvements make slow progress here and it is of all American cities the most like those of Mediæval Europe. The religious customs of the people are everywhere most in evidence and are the first to impress the visitor who is accustomed to the free and easy cosmopolitan ways of life in the United States.

PILGRIMS AND SHRINES IN CANADA

The shrine at Varennes is distinguished by the possession of a miracle-working picture of Ste. Anne, that attracts great crowds of pilgrims. Varennes has been a place of pious resort since 1692, and a beautiful church stands there, from which every year a solemn and stately procession, bearing the precious picture, sets forth, and, passing up and down the village street, makes glad the hearts of thousands assembled to do it honor. One other subsidiary place of pilgrimage is at the lovely little hamlet of l'Ange Gardien, just below the Falls of Montmorenci, where there is a consecrated shrine of Notre Dame de Lourdes, having a statue of Our Lady, before which a perpetually burning light serves to symbolize her unwearying intercession on behalf of those who put their trust in her.

But however deeply these shrines may be venerated, and however successful may be the prayers properly presented at them, they pale in interest before that of Ste. Anne de Beaupre, the oldest and most renowned of them all, known par excellence as la Grande Sainte Anne, because of the surpassing number and brilliance of the miracles that have been wrought thereat, or as la Bonne Sainte Anne, in token of the high place it holds in the affections of the people.

Ste. Anne de Beaupre is most picturesquely situated on the northern bank of the St. Lawrence, a little more than twenty miles below Quebec. It does not seem to be very clear just how Petit Cap, that being the primitive name of the locality, came to be indicated as the spot that Ste. Anne would delight to honor by her special blessing. According to one legend, in the early days of the Canadian colony some Breton sailors, being overtaken by a terrible storm whilst ascending the river, made a vow to Ste. Anne that, if she would rescue them from their present peril, they would erect a chapel in her honor on the first spot where they touched land. Scarcely had they made their vow when the wind fell, the waves sank to rest, the heavens shone blue above them, and presently they were safe on shore at Petit Cap. In fulfillment of their promise, they built a little wooden chapel, which, being too close to the river-bank, speedily fell a victim to the floods, and was thereupon replaced by a more substantial and more wisely situated edifice of stone.

While the foundation was being laid, a dweller in la Cote de Beaupre, named Louis Guimont, for many years a sufferer from a disease in the loins that bent him double, inspired by a religious fervor that enabled him to rise superior to his sufferings, managed to place with his own hands three large stones upon the growing walls; and lo! the third stone had scarcely been adjusted to its own niche, when there passed through the pain-racked toiler a strange feeling of exaltation and strength; and standing erect for the first time in many years he shouted aloud in wonder and joy at the miracle that had been wrought. The report of this marvel quickly spread. All the little world of that primitive community fell to talking about it, and among those to whom it brought a mighty hope was Marie-Esther Ramage, the wife of Elie Godin. She, poor soul, had been bowed down for a long time under an affliction that compelled her to drag herself painfully along by dint of crutches, and seemed beyond the power of human aid to alleviate. Hearing from her husband of how Louis Guimont had been blessed, she determined to seek relief from the same source. Forthwith she repaired to the holy spot and invoked Ste. Anne's intercession on her behalf. Her prayer was granted. Her infirmities departed from her, and she went back to her home rejoicing.

These miracles were followed by many others, not less remarkable, whose reputation, spreading abroad, ere long made the little stone chapel the most celebrated place of pilgrimage in Canada.

Twelve years after the erection of the church it became the treasury of one of the most precious relics the Catholic Church in Canada possesses; namely, a part of the bone of one finger of Sainte Anne herself. Sent in 1668 to Bishop Laval by the Chapter at Carcassone, it was confided to the care of Henri Nouvel, one of the Jesuit missionaries in New France, and first solemnly exhibited to the adoring congregations in the Chapel of Ste. Anne de Beaupre on the 12th March, 1670. The history of this inestimable treasure is thus told by Abbe Casgrain:

"During the reign of Marcus Aurelius the infidels invaded the Holy Land and destroyed all the monuments, public or private, together with the coffins they entombed. One coffin, however, escaped this sacrilegious treatment. The infidel iconoclasts could neither break it open nor harm it; and in their rage they cast it into the sea. But, strange to say, although of a prodigious weight, the coffin, instead of sinking to the bottom, floated lightly upon the waves until it found a resting-place in the sands near the town of Apt, in Provence. Here it lay hidden for a long time. One day some fishermen from the town caught in their net a fish so large that they had to disembark in order to drag it to land. When they had, after tremendous efforts, got the monster on shore, he took to leaping and throwing himself about with such energy and purpose as to dig a deep hole in the beach, and thereby bring to light the buried coffin. Forthwith the people gathered and sought to open it, but again it defied all efforts, and accordingly was, by the bishop's direction, deposited in a crypt which was then walled up, a burning lamp having first been placed inside.

"The centuries slipped away uneventfully until Charlemagne came to Apt as conqueror of Provence. He took up his quarters with the Baron Cazeneuve, who had a son deaf and dumb from his birth. Charlemagne, no less renowned for his Christian faith than for his martial prowess, ordered a purification of the church, which had, through the neglect of the people, become the abode of the owls and the bats. On the day appointed, all Provence assembled for the ceremony. In the very midst of the solemnities the deaf-mute, forcing his way through the throng, indicated to Charlemagne, by eager gesticulations, that he should cause a certain ancient wall to be torn down. Charlemagne not only gave orders accordingly, but with his kingly hands assisted in the work. The long-forgotten crypt was opened, and there, still burning brightly, stood the lamp lit many centuries before. The first to enter the crypt was young Cazeneuve, and scarcely had he set foot within it, when he cried with a loud voice that filled the whole neighborhood: 'In this sacred place reposes the body of the thriceglorious Anne, mother of the Virgin Mary.' The king, accompanied by the archbishop, then went down into the crypt, and after having made obeisance, opened the coffin without any difficulty, finding therein a perfect body with this inscription: 'This is the body of Sainte Anne, mother of the Virgin Mary.' "

NORTH AMERICAN TOTEMISM

What is a Totem? Broadly, the badge of a clan or tribe, but something signifying a great deal more than mere political or social alliance. It is not only a tribal emblem, but also a family signal; not merely a symbol of nationality, but also an expression of religion; not simply a bond of union among primitive peoples, but also a regulator of the marriage laws and of other social institutions. A totem is a "class of material objects which a savage regards with superstitious respect, believing that there exists between him and every member of the class an intimate and altogether special relation."

The use of totems seems to have been first noticed among the North American Indians, and the word itself is an Indian one. In the Ojibway tribe there are no fewer than twenty-three different totems, or clan divisions. Nine of these are quadrupeds, marking out the wolf, the bear, the beaver and other clans; eight are birds, five are fishes, and one is the snake. In other words, the members of the tribe who carry these devices by so doing mark themselves as belonging to a distinct division of it, to be for all time and for certain practical purposes distinguished and separated from the other divisions.

It is easy enough with totems of this character to imagine a basis of worship as the origin of the tribal badge, but it is not easy to see the meaning in other cases. For instance, the totems of some of the other Indian tribes are such things as corn, potato, tobacco-plant, and reed-grass; as medicine, tent, lodge, bonnet, leggings, and knife; as sun, earth, sand, salt, sea, snow, ice, water, and rain; as thunder, wind, and even as "many seasons."

Next to the North American Indians, the aboriginal tribes of Australia present the most developed form of totemism of any peoples of our time. Among the Australians is to be found the same use of totems as among the Indians, and chiefly taken from the animal kingdom.

TOTEM-POLES IN AN ALASKAN VILLAGE.

In Central America it is found among some of the tribes of Panama; and in South America it is found in Colombia, Venezuela, Guiana and Patagonia; and traces also have been supposed among the aborigines (not the Incas) of Peru. In Australia it is universal,—we speak, of course, always of aboriginal peoples,—and in Africa it appears to be general in the south and west, and on the equator. It is found alike in Bengal and in Siberia, in Polynesia and in China.

In Samoa it is said that if a Turtle-man ate of a turtle he grew very ill, and the voice of the turtle was heard in his inside, saying: "He ate me. I am killing him." If a Prickly-sea-urchin-man consumed one of these shell-fish, a prickly sea-urchin grew in his body and killed him. If a Mullet-man ate a mullet, he squinted. If a Cockle-man carried away a cockle, it appeared on some part of his person; and if he ate it, it grew on his nose. If a Banana-man used a banana leaf for a cap, he became bald. If a Butterfly-man caught a butterfly, it struck him dead. If a Fowl-man ate a fowl, delirium and death resulted. And so on, all going to show that among some totem peoples, if not among all, the totem has something of the quality of a fetich, as well as the significance of a family emblem.

Totemism has reached the most extensive development and use among the aborigines of Alaska and British Columbia. There they live in totem houses and every act is regulated by totem superstitions.

BERMUDA, THE ISLAND OF LILIES AND ONIONS

Easter lilies and succulent onions and potatoes together reach perfection in the Bermudas. Many thousand boxes of lilies, ready for Easter services in the cities, reach New York in the early spring and in the early autumn. Many hundred thousands of bulbs reach the same port for the greenhouses of the cities in winter.

Almost the entire export product of the soil in the Bermudas is lilies, onions and potatoes. In November and December the lily bulbs are planted in long rows, close together, and they grow slowly all winter. Early in March the shipment begins and during the month steamer after steamer is loaded with these delightful creations of nature. The stalks are cut low, retaining the buds and blossoms, and they are packed in light wooden boxes. They are sent to Hamilton, the chief town of the islands, whence the vessel takes them to New York in a voyage of about three days.

If a deep row of lilies about the altar of a church appears beautiful, it can be real-

BERMUDA LILIES—PART OF A FIELD OF THIRTY ACRES.

ized how superb is a vast field of these flowers set, as it were, in a frame of dark cedar trees. The lover of the delicate and beautiful can not look on such a glorious picture without a thrill of emotion.

The earliest potatoes to reach the cities of the United States come from the Bermudas, and with the three products, lilies, onions and potatoes, the scant forty square miles of territory in this group of nearly 400 islands is thus the year around almost wholly occupied.

The first discoverer, in 1522, was a Spaniard named Bermudez, whence the name. George Somers, an Englishman, was wrecked there in 1609 and there has been an unsuccessful effort made by English geographers to cause the group to be generally known as Somer's Isles.

NEGRO LIFE IN THE BAHAMAS

The reliance on the powers of the bush doctor or "obeah-man" is almost universal among the black people in the Bahamas, who greatly prefer him to the authorized practitioner. In some cases the remedies prescribed are simple, if not efficacious. A dose of sea-water is considered beneficial for a broken arm, and to hold salt in both hands is reckoned a certain remedy for various of the ills to which flesh is liable, and is also held to be of use in warding off ghostly enemies in the shape of evil spirits. Singularly enough, the same shield is used against the powers of darkness by peasants in the west of Ireland.

It is common when the bush doctor is consulted, for him to pronounce that the patient is suffering from an ailment caused by the presence of a beetle or a spider in *one* of the limbs. The doctor proceeds to extract the intruder, by sucking the afflicted limb, producing the creature from his mouth at the end of the operation, in proof of its efficacy. Spools of cotton, buttons, nails, and so forth are sometimes "extracted" in a similar fashion.

In his character as wizard, the obeah-man is in request to guard the crops of pineapples or oranges from the hands of the spoiler, the ships from storms and shipwreck, and the crew from death and disaster. Not a schooner leaves the port but has a bit of obeah attached for good luck to the mast, while beneath their shirts a string of charmed twine preserves the men from danger by land or water. Vacant houses are also protected from intruders during the owner's absence by the obeah-man. To effect this police duty, a bar is rolled up containing a few rusty old nails and some pieces of rushes, and laid on the threshold of the cabin; on seeing this mysterious ball, no negro dares to enter the house unlawfully. A rudely carved head, fastened on a tree, is a secure guardian for a cocoanut or orange grove, while a horn with a cork on it stuck full of pins and a bottle of water underneath, is a favorite protection against thieves or spirits. It would be a bold evil spirit who would enter the field so guarded; he knows right well that the pins would prick him and force him to enter the bottle of water; no negro would dream of intruding within an enclosure where such a bottle was displayed. When the obeah-man's charges are high, or faith is weak, occasionally the owner of a farm throws himself on the good feeling of depredators. Visitors may sometimes see a placard fixed to a post in a field of maize on which is painted the polite request, "If you steal the corn, do please leave the blades."

Though the obeah-man is usually resorted to by owners who may have been robbed of their goods, any one in authority may be appealed to on an emergency when no clue can be had to the delinquent. The following paper was one day sent to the governor's secretary:

"Mr. Secretary: Will you please have the person arrested who stole my clothes? This is the prayer of your humble servant, John Smith."

When free from physical pain and not immediately pressed by his creditors, of whom he has in general many, the darkey is full of enjoyment of life, and there is much in life for him to enjoy. What would be the object of wasting existence in wearisome toil or monotonous drudgery, in a delicious climate where a cotton garment is ample for comfort, and sufficient money can be obtained by a few weeks' "sponging" to supply frock-coat, chimney pot hat and umbrella for a man on high days and holidays; while a week or two spent in digging holes in which to plant maize—a labor that the little Congo gardeners decline to perform, on the grounds of its being especially the work of "femilly wimmany"—or in weeding the pine-fields, will procure for the women the wherewithal to purchase ostrich-feathers, white or colored satin boots, muslins and laces for festive occasions, amongst which funerals and attendance at divine service are not the least popular.

GATHERING BANANAS IN JAMAICA.

At a church a little distance out of Kingston in Jamaica, another island of the West Indies, the clergyman proposed to shorten the afternoon service so as to enable the congregation to take advantage of a street railway car that passed the church in returning to the city. On hearing of the threatened change a black man remonstrated with the rector. "Indeed, sir," he urged, "our ladies will nebber tink it worth while to dress merely to sit in church for one hour!" It must be observed that in the West Indies negresses are almost invariably spoken of as "ladies." At first it sounds peculiar to hear, "Missus, dere's a lady at de back door wants you to gib her a pair of old boots," or "Dat lady hab basket of eggs to sell," but one quickly gets used to it.

In speaking of "going for a few weeks' sponging" it must not be supposed that unsophisticated darkies resort to the civilized method of extortion known in colloquial United States as "sponging." In the Bahamas the term is applied to a cruise undertaken for the purpose of fishing up sponges from the banks of coral sand which extend for great distances in the archipelago. The water on these banks averages only three fathoms. On this submarine Sahara, the black, leathery, roundish lumps which, after undergoing much tribulation, eventually develop into the inviting-looking adjunct to the morning bath, have settled down, after their brief but erratic youth, to sedate repose in the crystal waters, till snatched from their retreat by the penetrating hook of the sponger.

Very unsightly and evil-smelling objects the sponges are when first torn from their native element, a sulphur stream or steeping flax being hardly more obnoxious to the olfactory nerve. Sponging has all the attractions of a gambling adventure. Should the cruise be successful, the profits are large and enough money may be made in a short time to ensure the enjoyment of months of idleness. And idleness is a real luxury when a man can recline under the shade of his own guava or orange tree, and have the latest news from the passing neighbors as they saunter along, their fanners (round flat baskets of palm leaves) piled with glowing tomatoes, large green avocado pears, or red and yellow peppers, for sale in town—or else chew sugarcane or smoke a pipe as the spirit moves him, taking no thought for the morrow, which is pretty sure to be sunny and balmy as today.

Dwellers in the dark and sombre north can hardly realize the charm and joyousness that seem to radiate from earth and air in the lotus-eating southern climes. The mere sense of existence becomes in itself a happiness; one can understand what animals probably feel in pleasant pastures on brilliant days. Then, as the sun sinks slowly downwards, the golden heaven glows over a rejoicing earth, flashing every moment into richer beauty beneath the departing rays, while rosy beams of light streaming upwards like so many auroras are a singular and very beautiful effect often to be seen in a Bahama sunset. When the sun has set new beauties appear, every bush and tussock becoming alive with thousands of fireflies; and when a silvery green moon rises in the calm deep sapphire sky, it is difficult to decide whether night or day be the more full of loveliness.

CUBA'S FIRST PRESIDENT

Cuba has gone far enough on its way toward independence to elect and inaugurate the first president of the Island Republic. The Cuban who will enter history with this noteworthy distinction is General Tomas Estrada Palma, whose name has been prominent in all the Cubans' struggles for freedom for many years. Of course, there have been provisional officials of Cuba during the periods of insurrection, but these organizations were only temporary, and were not calculated for any time except the period of warfare against Spain. Gomez, Maceo, Cisneros and Garcia are proud names in the history of the Cuban struggle for liberty, but the name of Palma must stand with them as that of a great man and a noble patriot.

General Palma was born in Cuba and was educated to be a lawyer. When the Ten Years' War against Spain broke out, his father, who was a rich planter in the province of Santiago, suffered many abuses and penalties for his support of the Cuban cause. His property was destroyed or confiscated by the Spanish, and his wife was killed. Young Palma went into the patriotic army and soon rose to a high rank in the insurgent forces. He was finally chosen president of the provisional government of the island. He was captured after nine years of fighting and was taken as a prisoner to Spain. He remained in captivity, because he refused to swear allegiance to Spain as the price of freedom, but after the end of the insurrection, he was released and came to the United States. For a time General Palma lived in Honduras, where he held important positions under the government, and married the daughter of the president of that Central American Republic. Returning to the United States he made his home in the village of Central Valley, New York, where he kept a school for Cuban boys whose parents desired them to have a genuine American education. At the time he was elected president, General Palma had not been in Cuba for twenty years.

At the outbreak of the Cuban Insurrection, which ended in the freedom of the island, General Palma became the head of the Cuban Junta in New York, and directed the organized support and assistance to his struggling countrymen. His energetic service against Spain brought him the worthy reward of being the first president of the Cuban Republic. General Palma is

TOMAS ESTRADA PALMA, CUBA'S FIRST PRESIDENT.

sixty-six years old, a man of education and thoughtfulness, conservative in his judgments, and admired alike by Cubans and Americans. His expressions after his election were such as to increase the confidence in which he was generally held. He defined his policy toward the United States as follows:

"The principal object of the Cuban Republic should be first to secure the most friendly relations with the American people who helped us in our hour of need. We will always bear in mind the work of the United States in helping us to obtain our independence from the Spanish rule. At the same time we should try to secure from the Washington government all advantages possible for our products by reasonable reduction of the important duties, especially on sugar and tobacco, as this is the only way for Cuba to escape the absolute ruin of these two industries which are the bases of its actual wealth."

The Cuban election did not develop much opposition to General Palma, as General Maso, the opposing candidate, had withdrawn. There were, however, some partisan expressions of dissatisfaction. It was charged by his political enemies that General Palma was the American candidate. It is impossible to believe, however, that he would at any time hold the interests of his own country as second to those of the great republic of the north. It may be assumed that he will be as patriotic a president of Cuba as he has been a citizen in working for the island's interests. At the same time he has the most friendly feeling toward the United States, from his knowledge of American conditions, gained by nearly twenty years' residence in this country. The vice-president of the Cuban Republic, elected at the same time with him, is Doctor Luis Estenez, once secretary of justice in General Wood's cabinet.

A COUNTRY HOMESTEAD IN CUBA.

SANTO DOMINGO—THE BONES OF COLUMBUS

Christopher Columbus, the discoverer of America, was born in Genoa, Italy, about the year 1435, A. D., and died at Valladolid, Spain, in profound obscurity, May 20, 1506. His body was deposited in a vault in the Convent Church of the Franciscans, where it remained for some time; but afterwards, according to a request made in his will, his remains were removed to the city of Santo Domingo in his "beloved Hispaniola," and placed in a small, enclosed vault in the cathedral. Just to the right of this vault were deposited the remains of Don Diego, the son of Columbus, who died at Montalban, in 1526; and long afterwards the bones of Don Luis, the grandson of Columbus, were brought to the same place. Thus there were three crypts in the Cathedral of Santo Domingo, one containing the remains of Christopher Columbus, one those of Diego, and the third those of Luis.

With regard to all these remains, the obscurity seems to have been profound until the year 1783. It was known to students of local history, that the remains of Christopher Columbus were somewhere in the building; but even the traditions as to his son and grandson were lost, or at least very vague. In that year, while making some slight repairs and alterations, a crypt was unexpectedly found, and in it a small metallic case, without any inscription, which was at once accepted as containing the remains of Christopher Columbus.

In the year 1796 the war between France and Spain was brought to a close, and the Spaniards were compelled to cede to the French all the Spanish part of the island of Santo Domingo; but by the courtesy of the French officials they were allowed to convey the supposed remains of Columbus to Havana, and the exhumation was solemnly made on the 20th day of December, 1795.

THE CUBAN FARMER.

On the 14th of May, 1877, the crypt containing the remains of Don Luis was accidentally discovered. This discovery caused much excitement, and revived an old tradition, that the bones removed in 1795 were not those of Christopher Columbus. The authorities now decided to make a careful investigation, which should verify, or else forever set at rest, the tradition. Their efforts were crowned with success. On the gospel side of the chapel (the left facing the altar) they found two crypts, the first one empty, because the remains had been carried away in 1795; the second one contained a small metallic case, with inscriptions in Spanish on both the outside and inside of the cover—"Most illustrious and renowned personage, Don Cristoval Colon," and "Discoverer of America, First Admiral." The chest was opened, only to increase the certainty; on the interior of the cover were found the words, "Most illustrious and renowned personage, Don Cristoval Colon."

On the two sides, and on the front, were the letters C. C., A., meaning Christopher Columbus, Admiral. Upon careful examination of the contents, there were found bones and bone-dust, very few and small, with a small bit of the skull, a leaden ball, and a small silver plate inscribed "U. Cristoval Colon."

Dr. Coppee says in his article on this subject in Stoddart's Review, from which this is mainly taken:

"Every one who was present at once accepted this ocular proof, that what was left of the body of the great discoverer had not been taken away to Havana, but was really there before his eyes, with an indubitable record of identification. It may be doubted whether in the wildest scenes of internecine strife and blood in all its history, Santo Domingo had ever witnessed such popular excitement. Time had brought them the knowledge of a great treasure. Te Deums were sung. The Legislature at once made an appropriation from 'the extraordinary funds' of ten thousand dollars as a contribution to a fitting monument. The archbishop, Roque Cocchin, kept his secretaries busy in sending the news of the discovery everywhere. . . .

"When the news reached the Spanish capital, it struck everybody, court and people alike, with painful surprise. The honor of Spain was supposed to be impugned. It was not only humiliating in itself, but it argued great carelessness in the Spanish officials, at the time of the translation, that for more than seventy years they should have fixed upon Spain the delusion that the precious remains of the great discoverer were resting in the Cathedral of Havana, and that generations of reverential visitors to 'the pilgrim shrine' had been wasting their sentiment on a mistaken object.

"The letter of the archbishop, with the accompanying proofs, was placed, by order of the king, in the hands of the most appropriate body, La Real Academia de la Historia. A special committee was appointed to take the matter in hand. Of course they reported adversely, charging the Santo Domingans with schemes and fraud, and absurd credulity.

"The controversy that ensued brought out a work of three hundred and thirty-seven pages from the hand of the archbishop. In this valuable work he goes over much historical matter not before generally known. An unprejudiced perusal dissipates every shadow of art or deception. Few things are so clearly proven, as that the remains of the great discoverer are still preserved in the Cathedral Church of Santo Domingo, the spot which he selected as his burial-place. It has been proposed to erect a lofty column over the sacred dust, which shall tell the passing ships of every nation of 'the gratitude of mankind to Christopher Columbus.'"

VOODOO WORSHIP IN HAITI

Voodooism is the "black art" of uncivilized negroes. Some of its more harmless forms exist wherever there are large communities of black people, and many of its charms and incantations are used even among the superstitious whites.

Back in the dark forests of savage Haiti, it reached its greatest power a few years ago, and a small contribution to a bush doctor would cause the restoration of anything stolen by a negro anywhere on the island. The doctor would not seek the culprit but would merely let it be known that a charm had been sold to the man who had been robbed.

The stories of the voodoo rites are indescribably horrible, and it has never yet been satisfactorily proven that they are all true. This much is known. Their special ceremonies and incantations take place in some secluded part of the forest where rocks or ravines make a natural barrier to observers. The devotees gather in a small circle around a basket containing the divine snake, which imparts any desired wisdom or knowledge to the priest or priestess in charge. Dancing about this circle by moonlight until exhausted, the votaries sit down and wait silently till the priest or priestess, who continues the dance, falls into convulsions, ending in a trance, during which the snake reveals the truth of any secret desired. After this the debauch of worship

THE HORRIBLE CEREMONIES OF VOODOOISM.

begins and with it the orgies of blood and cannibalism, if such be true, as several alleged witnesses have asserted.

Other forms of Voodoo worship are carried on in the towns by the witch doctors, and the superstitious, though not indulging in any of the worship, supply themselves with charms and observe the various means of warding off the work of evil spirits.

The word Voodoo comes from the word Vaudois, the name given to the followers of Peter Valdo, who founded the sect Valdenses or Waldenses of Piedmont. The historical massacre of these Christians in 1655 is remembered in Milton's sonnet,

"Avenge, O Lord, Thy slaughtered saints, whose bones
Lie scattered on the Alpine mountains cold."

The most horrible stories of cannibalism were told of these Christians and the French emigrants to Haiti gave the name Vaudois to the cannibalistic rites of the negroes. In Switzerland Voudai is the name given to a wild and monster huntsman, who is a sorcerer, voudai signifying sorcerer. In some parts of Haiti and Louisiana, Voodoo is the name of a Satanic personage who is given homage in a form of devil worship, and he in return gives special powers to those who sell themselves to his service.

It may be interesting to mention that from a source pretending to much more depth of learning comes the assertion that this widespread practice and worship derives its name from the Ewe language spoken on the west coast of Africa, in which vo means "fear of" and du means "a god."

It is claimed that large numbers of the Ewe Africans were sold to the slave traders by a conquering king and carried to Haiti. *The reason given to* explain why the rest of West Indies were so long free from Voodooism is that the English and Dutch took their slaves from the Gold Coast of Africa, where Voodoo worship was unknown. Also the introduction of Voodooism into Louisiana is accounted for from the importation by the French and Spaniards of slaves from Haiti.

The present condition of Voodooism in the West Indies is such that, if practiced at all in any of its barbarous rites, it is done with the utmost secrecy and official investigation has been unable to unearth it.

THE COCOANUT AND ITS USES.

Someone has aptly called the cocoanut palm the giraffe of trees, and beyond question there is a suggestion of that animal in the slender, curving trunk, with its feather-duster-like top of clustering branches and nuts. Found all the way around the world, in the tropical island and coast regions of Asia, Africa, South America, Australia, the Atlantic, Pacific and Indian Oceans, it is a wonderful tree of very great value.

In its natural state, the nut furnishes refreshing and nourishing food and drink. From the fiber of the thick, outer husk, cordage and cocoanut matting are made. The outer shell of the nut itself, and the wood are used for fuel in native dwellings, for which the leaves furnish a thatch, and the matting for walls, partitions and carpets. Thus every part of the remarkable tree is utilized.

The most valuable commercial products come from the meat of the nut. In some countries it is ground and pressed to extract the oil, and elsewhere the nut meats are permitted to dry in the sun, and then, as "copra," are shipped to Europe or America to be made into soap, cosmetics and toilet preparations.

PORTO RICO AND ITS CHARACTERISTICS

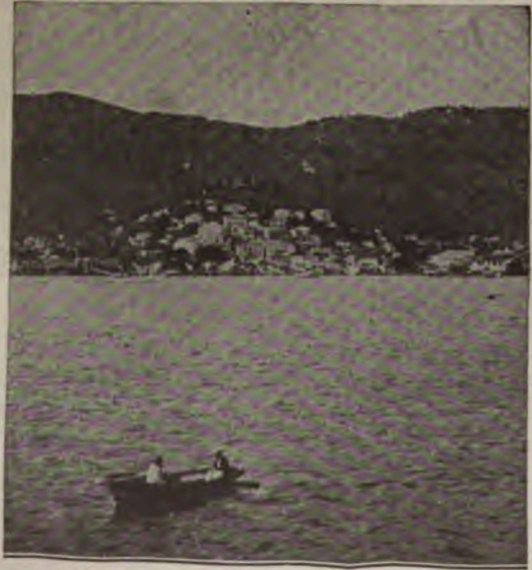
The United States ended its war with Spain, with the Island of Porto Rico and the little islands adjacent to it undeniably American possessions. There was no suggestion on the part of the people of Porto Rico that they should be left to form a republic of their own, as was planned for Cuba, nor did they oppose American rule as the Filipinos were doing. It has been necessary, therefore, only for the United States to establish a local island government under American guidance, and this has been done. The island, with its population approaching 1,000,000, is the most thickly settled of the larger islands of the West Indies. It was discovered by Columbus on his second voyage in 1493, and its largest city, Ponce, bears the name of one of its first governors, Ponce de Leon, the famous Spanish explorer, discoverer and undefeated conqueror.

When General Miles landed on the island with the American forces in 1898, he was welcomed joyfully by the people, who were glad to know that they were about to pass under the rule of the great American republic. Since that time there have been some political differences as to the policies of this government in its control of Porto Rico but these difficulties have been eliminated and the people today are prosperous and contented. The island is exceptionally salubrious and it has never been afflicted with epidemics such as have been common in Cuba. It has another point of exceptional interest in the fact that it is the "whitest" of the Antilles. It is the only one of the West Indian islands in which the negroes are outnumbered by the whites, who comprise nearly 600,000 of the total population.


HUSKING COCOANUTS ON A WEST INDIAN PLANTATION.

The resources are by no means fully developed, although the production of coffee, sugar, and tobacco is a considerable industry. Besides these staples, the island abounds in other tropical products, some of which but wait the investments of American capital and American energy to become highly profitable. Under American rule education is being fostered and the cleanliness of the island is being maintained to the manifest advantage of health conditions. San Juan, the capital, on the north coast of the island, is a clean and picturesque West Indian city, particularly interesting to American visitors for the historic associations that center around its old Spanish fortifications and public buildings. It was founded in 1511 by Ponce de Leon. With its richness of resources, its beauty of scenery, and its charm of climate, Porto Rico is sure to become a favored island among the newly acquired possessions of the United States.

The Spaniard for many centuries had everything his own way in Porto Rico and therefore in every respect the Americans found it to be thoroughly Spanish. The streets of the towns are often so narrow that two wagons pass with difficulty and the sidewalks are sometimes too narrow for two persons to walk comfortably abreast. The gloom is increased by the balconies that project from the second stories, where on evenings the families sit and talk across to one another. Ponce, with its close adjoining villages, has 50,000 inhabitants, although there are not more than one-third that number in the town proper. The seaport of Ponce is two miles away at La Playa which has about 4,000 inhabitants. Mayaguez has 12,000 inhabitants and is the place where Columbus first landed on the island. They have a monument to commemorate the fact.



VIEW OF HARBOR AND TOWN OF CHAPLATTE AMALIA, ST. THOMAS.

The introduction of American capital and American methods is rapidly developing the tropical resources of the island and changing the customs of the people. Railways are being improved and extended, new steamship lines are plying between New York and San Juan, new hotels and stores are being established. But nothing can change the beauty of the island.

bare earth where the fire had been, there were some shining white particles of metal. He examined them and found the out-croppings of a vein of silver. Then he remembered the dream of his boyhood, which had brought him there, in which an angel appeared and told him that he would be buried in a silver vault under a great church which he would erect in the far wilderness of Mexico.

Without disclosing his secret, he worked the mine alone for five years and the ore brought him $3,000,000. With this he opened it up on an extensive plan and before his death he had paid the royal fifth to the king of Spain amounting to more than $20,000,000. The rest of his fortune he spent in settling emigrants upon well-equipped tracts of land, and in due time he rested according to his dream in the silver vault underneath the great stone church he had built. But today his mine is only a cave for the little animals that remain in the surrounding fields and woods.

MAGUEY PLANT, FROM WHICH PULQUE IS EXTRACTED.

There are hundreds of mines in the unknown mountain regions which are worked by natives or priests who are contented with a bare sufficiency for support. Many of these are believed to contain fabulous riches equal to those whose one-fifth once made Spain the richest government and nation in the world.

The Santa Eulalia mines in Chihuahua are still rich producers, and the church still receives one sixty-fourth from the oldest of them as the result of a curious compact. In 1706 several desperadoes, confined in the prison, killed the guards and escaped to the mountains, where they defied every effort at capture. As their crimes were particularly atrocious, the vigilance of the authorities never relaxed and a large reward was offered to the Indians for the robbers' scalps.

Such honors were about even, for the desperadoes fortified themselves in a cavern having secret outlets deep in the almost inaccessible mountains, and made the region uninhabitable.

One day a few years later, an Indian came to the padre of the village bearing a letter which stated that the desperadoes desired forgiveness of church and state, not only because they now desired to live right the rest of their lives, but because the saints had prospered them so that they could make the padre and the governor rich beyond their wildest dreams.

The absolution and the pardon were soon secured, for which a vast amount of silver ore was turned over and a pact made that one sixty-fourth of the entire output of the mine should be set apart for the building of a great cathedral. In a few years the Cathedral of the City of Chihuahua was begun and completed and equipped at a cost of $2,000,000. The yield was above $2,000,000 a year for nearly a century. Then the Apaches overran the country and the mines were abandoned for many years. At this time efforts are being made to recover the lost wealth of the mines.

PULQUE, THE NATIONAL DRINK OF MEXICO

The Spanish conquistadores, when they landed in Mexico under the leadership of Cortez in 1519, found the natives cultivating the maguey for the sake of the liquor extracted from it. There are said to be more than thirty varieties of the maguey in Mexico, and from most of them pulque (pronounced pool-kay) and other beverages may be made. About two-thirds of the number yield "agua miel" or honey-water, and from about one-fifth of the varieties of the plant the best liquor, called "pulque fino," is produced.

The maguey is to the native Mexican what the cocoanut tree is to the South Sea Islanders. It yields food, drink, clothing, shelter, and useful things of all sorts. The fibers of the leaf are used as thread and twine, and by breaking off one of the sharp thorns in which the leaves terminate, and rolling and twisting together the fibers attached to it, you have a needle and thread ready for use. Ropes made of the fibers are strong and lasting, though they are not quite so good as homespun ones. The pulp of the leaves furnishes a writing material like that prepared from the Egyptian papyrus. The earliest Mexican manuscripts, adorned with drawings and illuminations, were written upon maguey paper. The large, strong, glossy leaves of the plant are also used to roof the houses of the poor, and from a leaf folded down its length spouts to conduct away the rain from the roofs are made.

The maguey is a plant of a striking and handsome appearance, and a great plain covered with row upon row of magueys at regular intervals, stretching uninterruptedly till the horizon or the boundary mountain range is reached, is a sight that cannot fail to impress the spectator. The leaves are eight or nine feet long, a foot wide and eight inches thick near the root. After several years there springs from the heart of the plant a great central shaft, upwards of twenty feet in height, and bearing many yellowish green flowers. But this exhausts the strength of the plant, and it soon afterward dies. As the maguey flowers but once in its life, and that only after many years of preparation, it is commonly known in the United States as the century plant, the notion being that it blooms only once in a hundred years.

The maguey on a pulque estate are planted in lines, with intervals of three yards between them. In suitable soil they require no attention until the period of productiveness is reached. This is by no means to be regularly calculated on; but it is believed that ten years may be taken as about an average time. By long and careful observation the natives have learned to know almost the exact time at which the great central flower-stem is about to appear. Just before this happens they cut into the plant and extract its heart, leaving only a thick outside rind serving as the wall of a reservoir, about two feet deep and eighteen inches across. Into this receptacle the sap intended by nature to supply nourishment for the tall flowering stem continually

QUITO, THE STRANGEST CITY IN THE WORLD

The capital of the Republic of the Equator, or Ecuador, occupies, among the capitals of the world, the position that some animals and flowers do in their respective kingdoms. It is a peculiarity, an anomaly, a paradox, if not a monstrosity. Just as some shrubs have leaves that simulate flowers, so Quito has some conditions which simulate the conditions of metropolitan existence, but the general effect is bizarre and strange.

Quito is a town of several thousands of inhabitants. No one quite knows whether there are forty or eighty thousand. Quitonians say that there are eighty thousand inhabitants; strangers doubt if there are so many as half that number. The first peculiarity is that there are no chimneys to the houses, and consequently no smoke rises. Charcoal only is burned there, and thus the town is relieved from that oppressive and noxious cloud that makes some cities occasionally intolerable. A second peculiarity is that while the streets are well paved with cobblestones in the roadway, you may pass days in the town and never see a wheeled vehicle at all. There are some carriages at Quito, but they are rarely used; when one of them rattles along, every one will turn to look at it, as at some curiosity.

A third peculiarity is that while the bulk of the population is Indian in its character, dressed in ponchos and short linen trousers, you will see a considerable number of people, white men, walking about in frock coats and wearing tall hats. These, you will find, are the enlightened and cultivated white men, natives of Spanish origin, who fancy that they form the nation of Ecuadorians—the Indians, of course, do not count. Every white man who can possibly manage it, wears, in Quito, a frock coat and a tall hat, to emphasize his importance and highly civilized condition. This dress justifies him in calling himself "Doctor," and others in so styling him. Another peculiarity about Quito is that there is no hotel there. There is, indeed, a restaurant which calls itself an hotel. There are establishments where rooms can be hired for lodgings; but hotel, properly speaking, there is none.

The means of access to Quito are also remarkable. In the midst of a wide upland moor, some hundred miles away to the south, a paved road suddenly starts, and extends, with more or less interruption, to Quito, which it enters from the south. Along a portion of this road, twice a week, a broken-down old omnibus, drawn by six mules, with their backs and necks in various degrees of hideous rawness, urged on by the shrieks and shrill whistling of three drivers, rolls slowly into Quito. This is the only public conveyance in the interior. One or two bullock-carts may be met upon the road. All other communication with the outside world is on horse or mule back. Such are the facilities of intercourse with this city of Indians, tall hats, and less agreeable things.

Quito can only be reached by a journey, mainly on mule back, which, including ordinary stoppages, may occupy ten days, over one of the most difficult roads in the world. Starting from Guayaquil, a steamer takes you seventy miles up the fine stream of the Guayas to Babakoyo, alias Bodegas. There the mules must be packed, and thence you ride for eight hours along a road which, in the dry weather, may be called good, to the foot of the Andes. Then comes a climb of 10,000 feet, part of it along rocky tracks to which the name of road can hardly be given. Then there is a descent of 2,000 feet to the valley of the Chimbo. From Guaranda there is an ascent of about 5,000 feet, and the shoulder of Chimborazo must be crossed. To cross Chimborazo, either you must go up to such a height that you run a considerable risk of suffering from mountain sickness, or you may go by a slightly lower road, and run a considerable chance of being suffocated in mud, which is often up to your horse's girths. From Chimborazo to Ambato the great bleak moors have to be passed. From Ambato the coach to Quito may be taken.

It will be imagined that in traveling over such elevations some of the roads will be very bad. During the journey one has, in fact, to go over every sort, from the finest paved causeway (almost unused) to entire absence of any track whatever. Sometimes the path leads over miles of rocks, which one could hardly imagine one could crawl along, yet which the mules manage to surmount. Sometimes it is through miles of mud, and through sloughs, where many poor beasts of burden are lying dead. Sometimes the slope is so steep that one wonders how to remain on the animal's back. Sometimes the road is converted into a torrent by the rain, or into a deadly slide where there is no sure footing; sometimes it has given way, leaving but a few inches for passage. Sometimes a landslide blocks the way, save for a few inches on the precipice's edge. Sometimes one must wander over the boggy mountainside, as the road has simply become an obstacle to progress.

In the mountains the road, be it said, is at least a mere path cut from their sides, until Chimborazo has been reached and the long Interandine Valley attained, which is the chiefly populated portion of Ecuador. The scenery is entrancing, or rather would be so if two things permitted the soul to be entranced. One obstacle is the enormous amount of clouds, which, though sometimes a beauty, often mar the scene, so dense and continuous are they. The other obstacle is caused by the necessity of careful attention to the road and horse, and of hastening forward as quickly as possible. Rest-houses are rare, sometimes mere Indian hovels,

ALBATROSS COLONY ON THE COAST OF CHILE.

The guano used for fertilizing American farms comes from the rocky islets where myriads of these birds dwell.

always foully filthy to a degree beyond powers of decent description. The rain is often torrential. When the road is dry, many of the difficulties and dangers disappear. But the cold winds on Chimborazo are often very formidable, and one must not stay long to admire his beauty. Apart from the glorious exuberance of the precipitous hillside forests on the maritime face of the Andes, and of the splendid sweep of the vast cereal-bearing valleys and slopes on the eastern aspect, there is much of surpassing loveliness; and, although in the rest-houses unspeakable filth and squalor prevail, there is interest and pleasure in the journey.

The climate is very equable. It rains for three hundred days in the year, and ordinarily in the afternoon. It is warmer out of doors than inside the house. A visitor is always requested to keep on his hat when he calls, as the rooms are so cold, and many people sit in their overcoats. The town is 9,300 feet above the sea, and to breathe is often a matter of great difficulty for the unacclimated. No stranger coming to Quito but wonders how he will ever get away again, and it is not likely that any person would wish to revisit this City of the Incas. Amongst the other deficiencies of this strange place is the entire absence of any cultivated society, with the exception of a few families. There are, on the other hand, some noisy military bands, and some of the tunes they play are lively. There is an observatory; but the astronomer has never yet taken the trouble to ascertain the true longitude of the place.

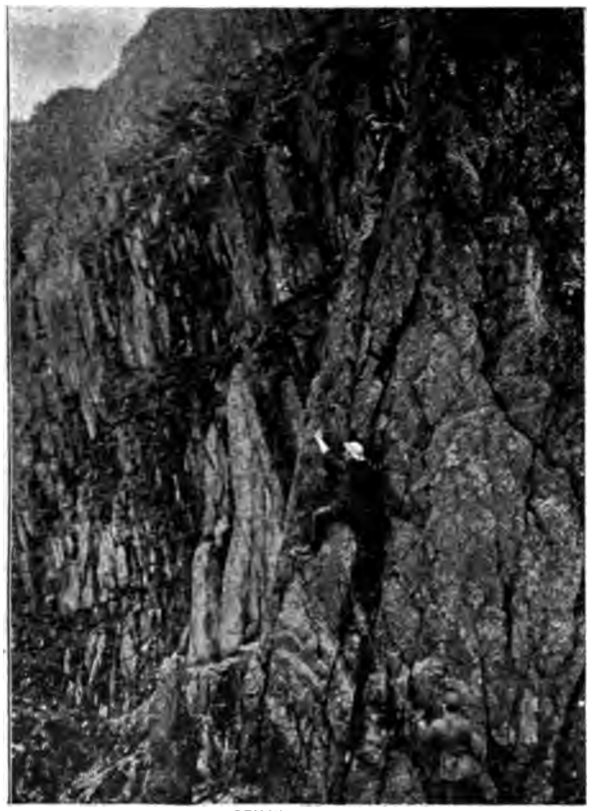
There are no greater thieves in the world than the Quitonians. If you pay a visit, your host unlocks his drawing-room door for you; the room is never left open. And each person leaving his room locks it behind him. Pilfering is a fine art in Quito. The article to be appropriated is moved from place to place till it vanishes entirely. The houses are built round courtyards and the reception rooms are very fine; the carpets, mostly manufactured locally, are superb. The address of the whites is most courteous; hands are shaken on leave-taking at least three times, and the hat is taken off on going down the staircase to the courtyard.

The post arrives regularly. You will not be troubled with business, as no one ever thinks of keeping an engagement, and you will feel a great and lasting relief when you have literally shaken the dust of the place from off your feet.

LIMA, THE CITY OF MUD

Where else in the world will you find a city built of mud 300 years old? Lima, the capital of Peru, has more than 100,000 people, and it is built of mud. It is about six miles around it and two miles from one side of it to the other. It has a network of narrow streets, which cross one another at right angles, with spaces clipped out here and there for parks and plazas. The houses are all of one or two stories, flush with the sidewalks, and in the business sections cage-like balconies hang out from the second stories, so that you are shielded from the sun as you pass through the city.

Lima looks wonderfully substantial, and you would imagine it to be made of massive stone, which here and there is wonderfully carved. Some of the walls look like marble, others imitate granite, and houses of all the colors of the rainbow line the streets like substantial walls. About the chief this country that was still living in the past, in the belief that its natural resources justified energetic development. And so they have obtained concessions from the Bolivian government by which they have large privileges in financial, mining, railway, agricultural and industrial enterprises, and it is believed that a new day is dawning for this "land of the llama." So we may ex-



MOUNTAIN CLIMBING.

pect to see the peculiar grass boats of Lake Titicaca superseded by American-built steamers, and the toilsome stage journey over the high roads of the Andes abolished in favor of an American railway train which shall penetrate the range by passes and tunnels. The rich forests of rubber, the gold and copper mines of the Incas, and the other natural wealth of this country will be levied upon to pay a tribute to Yankee energy and business sagacity.

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CLIMBING THE HIGHEST AMERICAN MOUNTAIN

Aconcagua is the highest mountain in South America, and consequently in the Western Hemisphere, for we have no peak in North America that equals it. The great mountain which rears its summit 22,422 feet into the air, or more than four miles, is in the Andes range, about 100 miles from the Pacific Ocean, almost due east of Valparaiso, on the boundary between Chile and the Argentine Republic.

Few mountain-climbers have had the hardihood to attempt this peak, owing to the difficulties of the ascent. You pant like a dying consumptive; then the dust, which smothers everything, gets into your throat and chokes you; you cough exhaustingly and pant worse than ever. Every effort, however slight, entails a fresh effort of will, and your only desire in the world is to give up the whole thing and get down. At times the view is indescribably splendid, but as a rule dust-storms blot out the sky. Rain never falls at these heights.

Starting from their camp at 8 a. m., the geologists of the first expedition that succeeded in reaching the top, and an Italian porter, gained the summit in nine hours. Owing to the violence and persistence of the wind, snow only lies in great patches on the peak. Avoiding these, they struggle up through deep masses of rotten, rock material, slipping back two feet for every three they stepped. During the latter portion of the ascent they were forced to stop every four or five yards for two or three surplus of horses that a good one could be bought for less than a dollar, and it was no uncommon thing to see a ragged vagabond on a horse holding out his hat to passers by and saying, "Alms, please, for the love of God." "If wishes were horses, beggars would ride," is the old saying that was long fulfilled in Argentina.

The soil being very loose in the country about Buenos Ayres there is always either insurpassable mud or almost unendurable clouds of dust. Besides this, ants are almost intolerable pests. They increase with incredible rapidity, and often the mud houses they build are large and strong enough to support three or four horses abreast. Buenos Ayres is nearly as large as any other two South American cities, having 750,000 inhabitants, one-half of whom are foreign. It is built on level land, and the houses, mostly of one story, have continuous low, flat roofs. There is a line of horse cars along every street, and these are well patronized, for few persons will walk farther than one of the long blocks.

Out on the vast pampas or plains, many of the great ranches, where there were formerly five or six thousand head of cattle or horses, are now converted into wheat fields, some of them several miles square. Within ten years of the time when wheat was imported into Argentina, nearly a million tons were annually exported.

Foreigners are known among the natives as Gringoes, and it is said that they received this name from a party of young Englishmen, the first in the country, who often sang together the old song, "Green grow the rushes O." Henceforth, all foreigners were known as "green grows" or gringoes.

The rage for speculation in Argentina since 1885 has resulted in building up the country at an incredible rate, and it resembles in many places the aspects of some of the "boom" districts of Kansas and Oklahoma.

COLLECTING ALBATROSS EGGS FOR MARKET ON A SOUTH PACIFIC ISLAND.

and is compared in general appearance to an English ash. It flourishes best on islands or ground that is periodically inundated, and requires the shade of other trees, as well as a still atmosphere, in order to give an abundant supply of the milky juice which hardens into gum.

It requires fifteen years to mature, and is not cultivated artificially, but the supply is practically inexhaustible, as it is reproduced by nature even after the temporary exhaustion of a district. This has occurred in the case of Cameta on the Tocantins, for forty years resorted to by thousands in search of fortune. There are many regions still untapped, and the known area of production, which probably will be largely extended, exceeds 1,000,000 square miles. The most prolific districts are on the lower islands of the main stream, and on its southern tributaries, on one of which there are 100 trees which yield 100 tons of rubber per annum. The manufacture of waterproof clothing from india rubber was introduced into France at the end of the eighteenth century, after which it was developed on a very extensive scale by the firm of Macintosh, of Manchester, which has left its name to this class of goods.

At this time the uses of rubber have so multiplied that a mere catalogue of them would fill pages. It is so common that we think little of it, but if the supply were to cease suddenly we would realize in full measure the importance which it has gained in our everyday life. Only to mention erasers, rubber bands, waterproof garments, rubber bags, medical and surgical supplies, rubber stamps, flexible tubing, springs and cushions and engine packing, suggests in slight degree the manifold applications to which the preparations of rubber from the South American forests are put.

FLOWER FARM IN THE SCILLY ISLANDS.
This group of islands lies just off the extreme southwestern point of England. The climate is mild, and many flowers are raised for the perfume manufacturers.

adjacent, is a center from which radiate a dozen famous streets on which every building occupies a historic site. This may be taken as the most typical center of London's social, official and political life.

Far from Trafalgar Square is another center of activity which is even more influential upon the affairs of the people of the world. It is the irregular area upon which the great financial institutions of London face. The Bank of England, the Mansion House, the Royal Exchange, and other institutions only second in importance to these, are neighbors here. The Bank of England itself, low, massive, and unpretentious in appearance, keeps from $75,000,000 to $100,000,000 in its vaults, and "the little old lady of Threadneedle street" is the most influential of all financial

CHEAPSIDE, LONDON.
Showing Bow Church in the Distance.

WESTMINSTER ABBEY.

factors in the world of English commerce. Cheapside, a typical London street, filled with handsome shops, leads from the bank to St. Paul's cathedral. Half way between is Bow Church, and according to London rule, everybody born within sound of its bells is a "cockney."

It is not far from the Bank to the Tower of London, by way of winding, narrow streets, for this is the oldest part of the metropolis. But within sight of the Tower and almost connecting with it is the newest of bridges across the Thames, the great Tower Bridge itself. This remarkable structure is unique in bridge architecture, and it never fails to arouse the utmost interest. Two great towers surmount the piers of the bridge, and are connected with the shore by permanent roadways, supheld. The central hall is 1,608 feet long. The immense structure is composed almost entirely of iron and glass, and it is still utilized for various expositions and amusement purposes.

A type of still another phase of the life of the great metropolis is shown in the illustration which depicts the vast Smithfield market and the streets adjoining it. This occupies the ground once used for the revels, miracles and tournaments of Bartholomew Fair, and later for the martyrdoms under Bloody Mary and Elizabeth. Here also Wat Tyler and Sir William Wallace were put to death. Nearby are the "Bluecoat Boys" school, Newgate, the famous prison, and other historic edifices. Today the market, with three and a half acres under roof, is the chief place for the distribution of market supplies, fruits, vegetables and meats, for the city of London. For a comparison with the market illustration elsewhere, observe the picture of South Water street, Chicago, where the food supplies of the great American city are bought and sold.

Every city of large size has its distinct individuality as truly as has every man. The study of cities is one of the most interesting rewards of travel, and the selected views of London here included will serve to typify for the reader the characteristics of that greatest metropolis.

THE CRYSTAL PALACE, LONDON.

This was built under the direction of Prince Albert, husband of Queen Victoria, in 1853, for the first International Exposition, the Pioneer of World's Fairs.

THE TOWER OF LONDON

On the left bank of the River Thames, just below where the Custom-House is, in convenient juxtaposition with the magnificent docks which, with their crowded tiers of shipping, their innumerable flags and ed it to the favored of their vassals. Armed men were ready to be let loose with fire and sword on the disobedient or discontented citizens of London; dungeons were added to the other chambers of the castle; prisoners of consequence were committed to its impenetrable walls; Jews were tortured till they surrendered the last farthing of their hard-earned gains. Patriots, like the Scottish Wallace, or the Welsh Llewellyn, expiated their hatred of oppression with their blood in these miserable dens; and by the time it had arrived at its greatest strength, and very nearly at its present form and extent, in the reign of Edward III., it was a name which created an involuntary shudder in the stoutest hearts. From it went in procession on their coronation days all the kings of England, from Richard II. to James II., a period of 300 years. The Tower throughout the life of the first of these potentates played a very conspicuous part. It was the scene of the grandeur and magnificence of his youthful days. Festivals and assemblies were held in it, that eclipsed the magnificence of the Court of France.

Tyranny, ambition, cruelty, ignorance and superstition, all by turns opened those dismal portals, which were only once again to turn on their hinges, when the murderer slipped in to do his dreadful work in secret, or the prisoner was openly conducted to death upon the scaffold. Nobles, warriors, heroes, statesmen, judges and scholars, even the beauty of women and the dignity of queens, could not escape the dreadful doom; and very frightful is it to read, in the records of that awful prison-house, the names of patriots and martyrs of which England is now so proud; and still more dreadful to reflect, that those great and illustrious names which still survive are but the scattered mountain-tops, as it were, on which the light of history has rested. But what are we to think of the valleys where the sunshine has never shone, the unnumbered, unnamed, unregarded prisoners who pined in those gloomy vaults, and counted the hours in vain, shut out forever from the upper world, condemned without trial, and executed without justice! We can talk now with some patience of these things, because they have ceased to be enacted for so long because the light of the Reformation and the law of the constitution have made their way into that unhallowed building as into our private houses, and modern civilization has converted it into an arsenal for arms, and a pleasant quarter for a few soldiers, a sight for tourists on their holidays, and a comfortable command for a time-honored general.

INTERESTING FACTS CONCERNING GREAT BRITAIN

The Established Church of England is Protestant Episcopal. The king is by law the supreme governor of the church. The number of Roman Catholics in England and Wales in 1891 was 1,500,000. The number of Jews in England and Ireland in 1891 was 93,200.

The total area of the United Kingdom, exclusive of foreshores and tidal water, is 77,109,000 acres; 13,504,000 acres are uncultivatable as mountains, waters, roads, etc.; 3,038,000 are woods and forests; 23,412,000 are grazing lands as hills and heather; 37,156,000 are under crop and grass. That is, the United Kingdom of England, Ireland, Scotland and Wales has a thousand years. The most illustrious tomb here is that of William Rufus, who is buried under the central tower. The magnificent and massive structure of Durham Cathedral is situated on a rocky eminence over the River Weir. Its most noted occupant is Venerable Bede, whose remains were stolen from Jarrow and deposited here in 1022.

The Cathedral of Salisbury was begun in 1220 and has a complete written record of everything concerning it from the first. Its spire is the loftiest in England, being 406 feet. It was completed in 40 years and cost more than $2,500,000.

Westminster Abbey, though not a cathedral, is the most noted place of worship in England. It is officially known as the Collegiate Church of St. Peter. The church was consecrated in 1065. William the Conqueror was crowned there in 1163. It is the burial place of thirteen kings of England and of five queens who were queens in their own right. Many of England's greatest literary men from Chaucer to Tennyson are buried there, not to speak of the great statesmen, scientists and warriors. Nearly all of the English kings and queens have been crowned there and since the time of Edward I. have used the same chair, underneath which is the holy stone of Scone. Its various parts have been constructed by the master architects of the world. In its law courts have been argued some of the greatest trials of England. No place in Great Britain has such a voluminous history as Westminster Abbey. Among the names that appear on tombs or memorial tablets in Westminster Abbey, are those of Chatham, Peel, Cobden, Pitt, Isaac Newton, Dr. Watts, John Wesley, Major André, Livingstone and Gladstone.

WELSH EISTEDDFODS, BARDS AND DRUIDS

An Eisteddfod is an assembly of Welshmen for the purpose of hearing speeches, essays, music and poetry in the Welsh tongue, for all of which subjects prizes are offered, frequently amounting to a very considerable sum. These meetings are known to have been held, as early as the sixth century, on an eminence near the now fashionable watering place of Llandudno, although the first, of which there is a detailed account, did not take place until 1176, when Rhys ap Gryffydd, Prince of Wales, held a congress in Cardigan Castle, on which occasion the prize for poetry was gained by a North Welshman.

The opening of the Eisteddfod is usually preceded by some mysterious ceremonies called the Gorsedd, for which a pedigree is claimed dating from 1,000 years before the Christian era, and which can be conducted only by those who are initiated into the sacred rites.

The place for holding the Gorsedd is usually an open space, in the center of which is a huge stone, the "Maen Llog," surrounded by a circle, thirty feet in diameter, of twelve other stones, supposed to represent the signs of the Zodiac. On the outside of the eastern portion of the circle three other stones are placed, in such a position as regards the Gorsedd stone, that lines drawn from it to them will indicate the rising of the sun in the summer and winter solstices, and the equinoxes respectively. The form which these lines, or pencils of light as they are termed, would assume in the mystic symbol of the bards and druids, and when written down appear thus, is in fact the druidic expression for the Creator of all things. To this Gorsedd stone a solemn procession is formed, which is at least curious and picturesque, owing to the peculiar dresses assumed by the different orders. The color of the bards is blue, to symbolize the blue sky, and supposed to indicate peace and tranquillity; the druids are dressed in white, significant of great purity; and the ovates or candidates for the highest orders are habited in green, to represent the grass of the field, which is typical of growth and progress.

Another singular custom is the carrying of a sword by a bard, who holds it by the point, to show that he is a man of peace, and would rather turn the weapon against himself than against any others.

On arriving at the circle, a prayer, said to have been composed 1,300 years ago, is recited to the following effect:

May Heaven grant strength,
And to strength add understanding,
And to understanding, knowledge,
And to knowledge, what is just,
And to what is just, love,
And to love, the love of all things,
And in the love of all things, the love of God.

As soon as the prayer is finished, the Gorsedd is declared to be opened, and the business of conferring degrees on the bards and ovates is proceeded with. Of the three orders the ovate is the lowest.

Under the old druidic dispensation, he was required to devote twenty years of his life before he could qualify as a bard, to gain which honor he had to study the laws and maxims of the institution, generally in verse, besides using his brains to compose fresh ones. At the expiration of his time he became a bard, which gave him the privilege of holding or presiding at Gorsedds, as well as instructing disciples, which was usually done in a series of pithy truisms called triads. Although they are full, even to repletion, of wisdom, they are characterized a good deal by repetition, and were sometimes not a little obscure to ordinary mortals who had not the advantage of studying them for twenty years; as for instance, "the three dignitaries of poetry are the praise of goodness, the memory of what is remarkable, and the invigoration of the affections." And again, "three things to be chiefly considered in poetical illustration,—what shall be obviously, what shall be instantly admired, and what shall be eminently characteristic." Some of these "proverbial philosophies" are rather graceful, as "the three primary requisites of poetical genius: an eye that can see nature, a heart that can feel nature, and a resolution that dares follow nature." Literature, however, was not the only thing that the bards had to look after, for morals also came within their scope, as we find that the three ultimate objects of bardism were "to form morals, secure peace, and follow everything that is good,"—a delightfully comprehensive view of the whole duty of man, which was still further carried out by "the three things forbidden to bards—immorality, satire, and bearing of arms."

THE ROUND TOWERS OF IRELAND

There exists, or are known to have existed, in Ireland at least 100 examples of the mysterious round towers. Eighteen of these may be classed as still perfect, or nearly so. About as many more have entirely disappeared, but their former existence is well authenticated. The rest, includingthose of which only the foundations remain, exist in various stages of ruin. The large majority of them stand detached from any other building, but some nine or ten were structurally connected with a church. Besides, these, there are, or were, two in Scotland, seven in the Orkney, Shetland and Faroe Islands, and one in the Isle of Man. These latter may be regarded as outlying members of the Irish group. There are, moreover, a few Round Towers in Italy, Germany, Belgium and France, which present a considerable resemblance to the Irish type, and are believed to belong to the same period or, at least, to be the outcome of the same movement.

The average height of the isolated Round Towers when perfect was probably about 100 feet. The average diameter at the base is about 20 feet, the thickness of the walls at the door level about 3 feet 6 inches, and the height of the door above the ground about 12 feet. The tower at Kilmacduagh, County Galway, is the largest example remaining. Though it has lost its conical cap and part of the upper story, it is still 120 feet high, with walls 4 feet 4 inches thick, and the doorway is placed as much as 26 feet above the ground. The towers generally start from a projecting base consisting or one or more plinths, diminish slightly in circumference all the way up, and terminate, when perfect, in a conical cap. The interior is divided into stories from four to eight in number, according to the height of the tower. These stories are in general marked by offsets in the masonry, or by corbels, or by holes to receive the joists. The floors appear to have been usually of wood, though in at least three cases, at Castledermot, Meelick and Kinneigh, the lowest floor is of stone. In the top story there are generally four apertures, but there are examples in which two, five, six and eight are found. There is generally a single window, variously placed, in each of the other stories; one of exceptionally large size is often found directly over the doorway. Individual Round Towers exhibit many important peculiarities not noticed in this summary description. But viewed as a whole, one of the most remarkable points to observe is the strong family resemblance that characterizes all the isolated Round Towers. It is impossible to mistake a member of the class.

ONE OF THE NOTED ROUND TOWERS.
Height, 84 feet; diameter, 15 feet.

Petrie's conclusions as to the origin and use of the Round Towers were stated by energy in supporting with piers and buttresses the most dangerous portions of the affected area. These works, continued from year to year, proved a fertile source of expense.

In 1784 the question arose as to the disposal of the relics of mortality which were to be removed from the disused Cemetery of the Innocents. It was suggested that the quarries should be still further strengthened, and rendered compact by their adoption as catacombs. The suggestion met with approval, was adopted, and the transfer of the vast accumulation of bones entered upon with all due precautions. It was thus that the quarries became the garner-room of the Destroyer; it was thus, as the various cemeteries within the city ceased to yawn for their dead, that they were made to yield up their silent tenants. In 1786 the catacombs were solemnly consecrated. At this period the bones and skulls were being cast down on the floors of the caverns and passages in great heaps, without any attempt at order or arrangement; nor was it till the year 1812 that the authorities commenced the work which has culminated in the present artistic presentment of that which once formed the framework of living thousands.

Come! we will descend together as two members of the public, and see a portion of this underground and silent world that extends its ramifications beneath 200 acres of Paris. We are in possession of our "permits," and according to direction find ourselves at the principal entrance on the right of the Place Denfert-Rochereau.

One o'clock strikes. The door guarding the entrance to the ninety steps that lead below swings open. Its harsh grating is the signal for a brisk fusillade of match-firing reports. The matches are applied to the candles; a strong odor of tallow seethes through the mellow sunshine, and through its sickly fumes we commence to slowly advance. Already the leading file has vanished within the doorway, and as we in turn approach the orifice a dull roar pours sullenly out to meet us. Tramp, tramp, tramp—we have passed beneath the archway, we are descending the spiral of the stone staircase. The air is heavy with the clangor of ponderous footfalls, murky with candle smoke that veils with weird effect the flickering, draught-driven light. As far, and just so far, as we can see above and below us, all is in movement; dresses, coats, candles whirl slowly, uncertainly downwards. The very walls seem to writhe in the uncertain light, to mutter and moan with inarticulate voices.

Down, down, down! All are in the rock-home of death. A moment's pause, a silence falls on the chattering crowd. Then, affrighted with their second's fear, they sway onwards through a rocky gallery. Rock on either side of them, rock above them; here bare and arid, there slimy with oozing water and foul growths. The passage broadens out, it narrows, and ever and ever there is the black line on the roof that marks the road. Suddenly a black shadow on the left or to the right. The eye plunges into the depths of these side roads, and recoils aghast at their mysterious gloom.

The lights file on. Still, forward, the shadows to right and left grow in size; some have a sentry silently guarding their obscurity from rash obtrusion; where there is no sentry there is a chain. Suddenly the rocks on either hand contract, change color, and break out into the gruesome design of a symmetrically built wall of bones and skulls. From the level of our heads down to the level of our feet, skull rests upon skull, and leans back against the myriad bones behind. The shivering candlelight falls with unequal rays upon the formal tiers; it flashes coldly upon the grinning teeth, penetrates the mortarless crannies of the wall, and ever shows bone of many shapes and curves. The designs in skull and bone become more complicated. The walls become more lofty, rush from straight lines into curves, assume the form of chapels. Around and about you are skulls, skulls, skulls. But even as you dream in one of these chapels, a faint, prolonged rustle comes stealing to the ear, and vanishes mysteriously as it came. The guide catches an inquiring eye, and explains that it is the rats moving. He makes the blood run cold with the horror of his account of those who have been lost in the catacombs and hunted to their death by the sharp-teethed rodents.

We grow thankful that, as two of the public, we move on and on to the exit at the Rue Da~eau, and find there life and sun-

PALACE OF FONTAINEBLEAU.

FONTAINEBLEAU

No public building in France appeals to the historical imagination more eloquently than the palace of Fontainebleau. None awakens so rich and varied a group of striking associations; none is so thickly haunted with memories of the past; none is tenanted by the ghosts of so brilliant a crowd of famous men and women. It is a document to which twenty kings have set their sign-manuals, a chronicle in stone of the history of France, a dumb yet eloquent preacher of the mutability of human greatness.

Successive sovereigns from 1137 to 1870, from Louis le Gros to Napoleon III., have enriched it with memorials of their rule. Within its precincts, by ancient custom, the royal wives of monarchs have brought into the world the heirs to the throne. Upon its buildings the uncrowned queens of France, from Diane de Poitiers to Madame de Pompadour, have lavished their luxury, their caprice, and their extravagance. The ermine of Anne of Bretagne, the porcupine of Louis XII., the pierced swan of Claude of Lorraine, which are so conspicuous on the walls and ceilings of Blois, are absent from Fontainebleau.

Seven centuries of changing taste have

in a hut of two rooms. The cottage, or hut, now leans in all directions, and the floor resembles the waves of the sea. It is bare of furniture, except such as the great Peter used, a bedstead, a table and two chairs.

But the walls of this historic hut, only ten by twelve, are covered with the names of visitors from all civilized nations. Over the old-fashioned chimney a marble tablet was placed by Alexander of Russia in 1814, with the inscription: "Alexander, to Peter the Great." The whole hut is now encased in a building, erected for its preservation by a former Queen of Holland, Anna Pavlovna, who was a Princess of Russia. But "Peter Michaelhoff," finding himself an object of too great curiosity at Zaandam, went to the shipyards at Amsterdam, which were enclosed by a high wall. He there completed his apprenticeship, and in off hours constructed with his own hands the model of a man-of-war, which he took with him to Russia as a model for the great Russian navy. Eighteen years after, he came back to Holland with his wife, the Czarina, to visit with her the shipyards where he had worked as a day laborer, and had lived upon his pay as "Peter Michaelhoff." The anniversary of this visit is still observed at Zaandam as a holiday; and in commemoration, the name of the town is written Saardam and Czardam.

And yet with all this historic association Zaandam is one of the Dead Cities of the Zuyder Zee. It is but a small town, if even such it may be called, with its detached cabins, painted bright green with red roofs, seen amidst scattered trees. Its canals are dry, and serve as roads; yet its cabins are said to contain china and old carved furniture fitted to delight the heart and excite the envy of a nineteenth century antiquarian, searching for decorative household treasures of the past.

Its four hundred windmills now make flaxseed oil, and their owners are city millionaires. But desolation reigns in Zaandam; the only life is in its oil-mills, bewildering and confusing in their turnings and twistings to the point of vertigo.

Alkmar, another of the "dead cities," is celebrated for its famous victory over the Spaniards in 1573— a victory that put fresh life into the Dutch cause, and was a turning-point in their favor. It was once a prosperous city, but is now only a well-kept village, celebrated for its cheese and wooded walks.

Broek, once the capital of North Holland, is now only "the cleanest village in the world." It is curious, interesting and clean, but the life has been washed out of it; its inhabitants seem turned to stone. The front doors of the one-story houses are never opened except for a marriage or a funeral, and the stillness of death is in its streets. Yet once across the threshold of these primitive homes, rare antique carved furniture, old china and Dutch curiosities crowd the "best room," while the curious old costumes of the few inhabitants have an enchantment all their own.

Mannikendam is another of the Dead Cities of the Zuyder Zee, and is more dead than any of the others. No living creature is to be seen along its brick-paved streets, not ever a dog or a cat. Not a door nor window of its red-painted houses, with green Venetian shutters, is open. It was once a flourishing city of commerce, one of the twenty great towns of Holland. Strangers seldom visit it now, for street after street, lined with closed houses, all seem to say, "We belong to a past age."

And it is true. The few descendants that remain of the thrifty Dutch of Monnikendam care as little for the modern world as the world cares for them.

MARTIN LUTHER'S PRISON, WARTBURG CASTLE

There is no German, however little informed as to the history of his country, whose patriotic sentiments are not stirred when speaking or hearing of Wartburg Castle. There are castles in Germany with scenery around them as lovely; the legends connected with Wartburg Castle are but of transitory interest, and memorable only so far as giving to us vivid glimpses into the superstitious character of those times; to many people, particularly to practical Americans, who possess nothing of the kind in their history, they may seem ludicrous even when considered as mere improbable stories; and the moral which is attached to many of them remains unappreciated or undiscovered. Luther found an asylum at Cobourg Castle as well, and there wrote the most celebrated of his hymns, "Ein' feste Burg ist unser Gott—A castle strong is our Lord God"; in local historical reminiscences and mediæval adornments the Castle of Nuremberg is to the Southern Germans, and Marienburg Castle, in East Prussia, to North Germans, undoubtedly dearer, because nearer and more directly associated with the histories of their native provinces.

"The cause of this prominent and remarkable fact," says the venerable poet and historian Storch, "is that every German of the present day, be he aware or unconscious of the special acts in its history, considers and venerates the Wartburg as Germany's sole national sacred relic, as the stronghold from which radiated the light of German mind, as the hallowed spot whence sprang the liberty of German thought, as the battle-field in the victorious and untiring struggles of German genius. That which makes of the German a real German, which constitutes him a soldier of and gives him a foremost place among the pioneers of civilization, namely, the precision and the clearness of German knowledge, and the courage to declare and maintain the truth of knowledge in the face of all the world, this characteristic feature of Germanism, we not only find symbolically indicated but even distinctly manifest in the past history of Wartburg Castle."

WARTBURG CASTLE—WHERE MARTIN LUTHER WAS IMPRISONED.

The bold reformer, Dr. Martinus Luther, had just stood before Charles V., that young but mightiest of German emperors since the days of Charlemagne. He had spoken before the assembled magnates of the empire at Worms, consisting of the Emperor, the Archduke Ferdinand, six electors, twenty-four dukes, seven margraves, thirty bishops and prelates, and princes, counts, lords and ambassadors without number, on April 4, 1521. "And if there were at Worms as many devils as there are tiles on the roofs of its houses, thither I will go," he had replied to the entreaties of his anxious friends, who justly feared for his life. And when he entered the glittering hall where the Diet held its sessions, when stepping through the ante-chambers filled with men-at-arms, just at the entrance of the great hall, the old veteran general, George of Frundsburg, the Imperial Chief of the Landsknechts, while encouragingly patting his shoulders, had said: "Little monk, little monk, thou walkest to-day upon a difficult and dangerous road, such as I, though often standing before mighty dangers and in the turmoils of deadly strife, have never as yet marched upon; but if thy cause be just, fear thee not, for God will not then abandon thee!" He had just stood but not trembled before the mighty Emperor, and had answered the demand to recant by those memorable words, "Unless I be refuted by Scripture or the most unanswerable arguments, I cannot and will not recant. Here I stand; I cannot do otherwise; may God help me, Amen."

The friends of Luther were in sore distress for his safety; above all, the Elector, Frederick the Wise, of Saxony, his most powerful patron and friend. Such was the fear of the Emperor's authority, however, that the Elector even did not wish to be personally concerned in any plan for the protection and safekeeping of Luther; nor did he wish to know where he was to be brought into security; "that with reasonable truth I may be able to excuse myself of any knowledge of these things," he remarked to Spalatin, his private secretary and court-preacher. Luther had already at Worms received some mysterious hints as to the projected undertaking to carry off his person and protect him against the consequence of the Emperor's decree.

His return from the Imperial Diet was like a triumphal march. Alttersfeld in Hessia, the Abbot with the dignitaries of that ancient ecclesiastical city, received him outside the gates, banquetted him and insisted upon his preaching before the assembled people, although this was against the strict Imperial prohibition. At Eisenach the burghers turned out en masse to welcome him. In the same night, at Erfurt, while he slept tranquilly in "his dear town," the students, his youthful admirers, revolted because the Dean of the Cloister of St. Severus had pushed Dr. John Drach, a tutor at Erfurt University, and one of the Reformer's adherents, from the steps of the high altar. On the day following, the 2d of May, Luther preached at Eisenach before his traveling companions, who were now to leave him, with the exception of the doctor of theology, Nicholaus von Amsdorf, to return to the town of Wittenberg by way of Gotha; while Luther turned aside to Moehra Village, near Salzungen, to visit his kindred, where he met his old grandmother for the last time, as well as his uncle, Heinz Luther, a simple-hearted peasant.

When he arrived he met his brother Jacob quite unexpectedly. On the 4th of May, after having preached under an old linden-tree to his kindred and humble peasant friends, he continued his journey, accompanied by his brother Jacob and the inhabitants of Moehra Village, as far as

Waltershausen. Dr. Myconius, the pastor of Gotha, is also said to have been with him. Thus, in a simple country wagon they passed Waldfisch Village, then the larger one of Schweina, through which they drove between four and five o'clock in the afternoon. They had now arrived at the foot of the steep hill near Altenstein Castle, where Luther made the driver slacken the pace of the horses, and requested his friends and kinsfolk to return. It was already dusk when they entered into the high-road near the ruined chapel overlooking the lonely narrow pass through which the road wound. There suddenly broke from the sombre shades of the woods a horseman in armor, with lowered visor and lance at a charge, followed by four heavily armed companions. Brother Jacob was the first to jump from the wagon and escape (little aid, our valorous brother, he was!), while one of the assailants seized the horses' bridle-reins and roughly called upon the driver to know "what sort of people he had in his wagon?" at the same time striking him with his bow so severely that the poor fellow fell beneath the feet of the horses. In the meantime two of the knights had informed themselves as to the person of Luther, and one, putting the drawn bow upon his breast, demanded his surrender. The companions of Luther remaining with him, Doctors Myconius and Amsdorf, implored the knights that he be treated mercifully; but Luther, who evidently understood the situation perfectly, whispered to his friends, "Confide, amici nostri sunt"—"Be of good cheer; they are our friends." Luther was now taken from the wagon, his monk's cowl was torn off him, a "gepner"—knight's cloak—put on instead, he was led into the woods and put on a horse by the friendly kidnapers who were rescuing him.

While in wild anxiety, Brother Jacob hastened back to Waltershausen to spread the sorrowful news of Luther's capture, Amsdorf and Myconius journeyed to the same town in a much easier frame of mind; and the knights with Luther penetrated deeper into the wilds of the forest, where they bound another man upon a horse so as to make it appear as if a batch of dangerous criminals had been captured by them. They now made a considerable detour toward the foot of the Jusel Mountain, the highest peak of the range, in order to deceive the wood-cutters and charcoal-burners as to their real destination, and they arrived at Wartburg Castle shortly before midnight. It was in the night from Saturday to Sunday that Luther first set foot into the now memorable chamber. "I've ridden nigh fifteen miles, I am tired and weary," he afterwards wrote to friend Amsdorf. To deceive the inmates of the castle, who had crowded together to see the late unexpected arrival, he was roughly spoken to, pushed into his cell and the door locked upon him.

The secret of his capture and imprisonment was so well kept that one hundred years elapsed ere the circumstances, as here related, were generally known among the people.

Luther's residence at Wartburg was not without interest. The Governor of the castle, a nobleman of ancient lineage and immense wealth and full of pride, became his friend; the Governor's haughty eye soon felt the influence of that "falcon-eye," as Erasmus of Rotterdam forcibly describes it. Luther was thirty-eight years of age at that time and still unmarried; he had not yet found his Catharine of Bohra, and he looked quite different from the oil-painting by Lucas Cranach, which was taken in later life, and according to which we generally fancy him, when conjuring his picture to our mind's eye, a portly, stout, well-to-do old gentleman, of serene and happy countenance, with a double chin.

His chief work, as we know, was at Wartburg, the translation of the Scriptures. But he neither there translated the entire Bible, as is often supposed, nor did he employ much time in what he translated. He soon perceived the difficulty of translating the Old Testament by himself, and wrote to Amsdorf on the 14th of January, 1522: "Without your aid I cannot enter upon the Old." The New Testament, as this day used in the Protestant Churches of Germany, was translated by Luther in the short space of two months.

THE KREMLIN OF MOSCOW

The Kremlin is a colossal volume of Russian history, with many chapters and a long index of pages. It is a record of memorable events extending through centuries. It is the heart and soul of Russia. It is the great central fortress of this mightiest empire of ancient or modern times. It is the throne of the Emperors. Here they have been crowned for ages. They would not dare to be crowned elsewhere. Here their thrones and crowns, and imperial regalia are deposited for safekeeping for the admiration of posterity. The Kremlin is the grand sanctuary of religion. It is the center of Russian cathedrals and the consecrated residence of the Holy Synod of the Greek Church and her Metropolitan Bishops. Here they perform the coronation ceremonies and anoint the sovereigns of Russia with holy oil; and on these occasions the imperial court of Russia exhibits scenes of superlative magnificence, upon jeweled thrones, with diamond crowns, and precious stones of inestimable value.

The Kremlin is the pride of Moscow, the holy city of all Russia. It was the chosen abode of the old Muscovite Princes, the long residence of the old Tartar sovereigns. It is the sacred Alcazar of the Slavonians, the great Northern Acropolis, the far-famed Alhambra of the Russians. And it is the venerated mausoleum of the imperial family from Ivan the Terrible down to Peter the Great. Here are the tombs of the Patriarchs taking their long slumbers with the mighty monarchs whom they crowned. It includes all that is most precious and sacred to the Russian race. In viewing this colossal collection of palaces, cathedrals and towers, the spectator is supposed to stand upon the south bank of the river Moskva, above the massive stone bridge, with its seven arches. The Moskva is here two hundred yards in width. Immediately behind the spectator on the broad street where he stands, is a long range of high buildings on the same side of the river, and about one-third of Moscow. The current flows to the right along the walls of the Kremlin, leaving a broad carriage-way between the walls and the river. The finest view of the Kremlin is obtained from the Moskvietskir bridge.

It derives its name from the Tartar word *Krem,* signifying fortress. It is a tall city in the center of Moscow. It stands on a hill. It is elevated like a mighty salver, laden and filled with palaces and cathedrals, high above its surroundings. It is tinct chapels could be erected under one roof, in such a manner that divine service could be performed simultaneously in all without interference one with another. This terrible monarch, it is said, was so much pleased with the edifice, that he caused the eyes of the architect to be put out to prevent him from planning another like it.

Of the five gates of the Kremlin, we only stop to describe one, the Spass Vorota, the gate of the Redeemer, near the St. Basil Cathedral. Over this gate is a picture of the Savior under glass. It is held in greatest reverence by the Russians. This gate forms a passage through the tower of about twenty paces. Every one, monarch, high or low, must take off his hat here and keep it off till he passes through. Its sacred reputation has continued for centuries. The Tartars could not pass it. Miraculous clouds, it is said, veiled it from view. There is a sort of legend that the French army could not force an entrance by this gate. They attempted to blow open the gate with cannon; but the powder would not burn. They built a fire over the touch-hole; but the powder exploded the wrong way, and killed the gunners, so it is said.

Let us next ascend the lofty tower of Ivan. It is the highest tower in Moscow, exceeding two hundred feet. It has numerous stories or belfries, affording fine views as the visitor ascends the staircase. Close behind this tower, and near the entrance, stands the monster bell of Moscow, the greatest the world has seen. It has excited the wonder of ages. It is called the Czar Kolokol or King of Bells. It is twenty-one feet high and twenty-two in circumference. Its weight is over seventy tons. It is said to be worth, as old metal, more than half a million dollars. It fell from the tower in 1737, and broke out a piece six feet long and three feet wide.

We ascend to the first story, in which is hung a solitary bell, weighing sixty-four tons. It requires the strength of three men to toll it three times a year. Ascending the upper belfries, we find more than forty bells in this tower, diminishing in size as we ascend. On Easter Eve a death-like silence reigns in all the streets, till on a sudden, at midnight, the thunders of the guns of the Kremlin burst forth, and the clangor of all the church bells of Moscow, many hundreds in number, are heard resounding over the city, while countless thousands of the inhabitants come forth, and with one voice all repeat the words, "Christ is risen," and all evince great joy at the glad tidings.

We reach the summit of the tower, and look abroad over the most magnificent scene in Europe. Clustered around the tower upon which we stand are thirty-two churches, including the cathedrals within the walls of the Kremlin. We look down upon them all,—domes, towers, golden spires and imperial palaces. Beyond the walls of the Kremlin the eye wanders over the whole city of Moscow with its five hundred churches, and countless domes of green and red, starred with gold, glittering spires pointing upward in rich profusion over the city landscape far and near. What mighty and memorable events, and what tragic scenes have occurred and been witnessed within the purview of this high tower! Fearful calamities have visited Moscow along the line of its history. Six times it has been devastated and nearly destroyed by fire or sword. Tamerlane, the Eastern Destroyer, began the list of fearful tragedies and ravished it. Next it fell into the hands of the Tartars, who sacked it, and put many of the inhabitants to the sword. Again in 1536 it was nearly consumed by fire, and two thousand of the inhabitants perished in the flames. In 1571, the Tartars fired the suburbs, and a furious wind drove the flames into the city, and not less than 100,000 persons perished by fire or sword. In 1611 a large portion of the city was again destroyed by fire.

The terrible scenes in the modern burning of Moscow by order of Count Rostophin are still fresh on the pages of history. It was a fearful sacrifice to destroy this sacred city of the Russians by their own hands. But it sealed the doom of Napoleon and his grand army. This massive old tower has, however, stood firm amid all these scenes of blood and fire. Turn your eye down now upon the ground and look along the walls near this tower, and you may count 876 cannon which once belonged to the grand army of France, which were left, or lost, or captured, or buried in the snows of Russia on that terrible retreat.

It is not strange that Moscow and the Kremlin hold such a place of reverence and affection in the hearts of true Russians. From Sparrow Hills, three miles away, Napoleon caught the first view of Moscow in all its pride, grandeur and magnificence; so, from these same hills, a few days after, he took a sad, lingering look at the same city enveloped in smoking ruins.

But Moscow has arisen, liked the fabled Phœnix, from its ashes, and now appears far more magnificent than before, as the great commercial metropolis of Russia. It is the truly Russian city, little modified by European influence, and far more interesting to the stranger than St. Petersburg.

HUNGARIAN GIPSIES

Inhabitants of all countries and natives of none, these children of nature call themselves Rommany. Until George Barrow enlightened us as to the habits and dialects of these wanderers, it was believed that their language was a mere incongruous polyglot of every language under the sun, consisting of inversions and contortions of words and slang expressions. This has all been shown to be erroneous, though many of our own slang words come from the Rommany. "Pal" is pure Rommany for brother. The half-contemptuous expressions of "Fiddle-sticks" and "Fiddle-de-dee" distinctly come from the same language, and "Bosh" is Rommany for fiddle.

They are all more or less musical, though in England rather less; in truth, the English gipsy seems to be disappearing entirely, emigrating perchance, or dying out. Except, as far as can be ascertained, in Hungary and Transylvania, they have no fixed habitations, or legitimate callings, living in most countries on the "glorious gospel of haphazard" principle, in a half-hearted sort of way, upon their wits, their cunning and fortune-telling. They scarcely ever resort to violence, being of a too lethargic temperament to exert themselves about anything except when they grow jealous, and then their action is swift, fierce, and often fatal. Gipsies come of a very ancient Indian stock, so ancient indeed as to defy all attempts to trace their origin, and were unquestionably the victims of some dire vengeance, and, most likely, were dispossessed of all their belongings and lands by some other ancient race, even to their belief in themselves and their god or gods, for now they neither the public, and it was, as he acknowledged himself, their influence that had such a marked effect upon the style that he adopted, and tended to develop that genius that made him famous. In return he wrote a history of his favorite people, and set to music many hundreds of songs depicting their life and legends as written by the poets.

THE REFERENDUM OF SWITZERLAND

Fifty thousand voters in Switzerland, by signing a petition, can have any law that has been passed by their assembly or legislature submitted to the people for ratification or rejection. This system, known as the referendum, went into effect in 1874 and has been followed satisfactorily ever since. In the census of 1901 there were 728,681 qualified voters, but at the elections there are rarely more than half that number of accepted votes cast.

The town meetings of public school districts in the rural parts of the United States are the nearest form we have of the plebiscite or referendum, of which the law in Switzerland is the best example in national affairs. In favor of the plebiscite, as the vote of the people on legislation is called, the following arguments have been mentioned:

It is a calm appeal to the will of the people, "yes or no" on a given piece of legislation. In other words it is making a jury of a community or nation. It arouses the interest of voters in measures of public policy rather than in political bosses and politicians. It increases the stability of legislation, for acts of legislation are not so likely to be passed and then repealed as often happens in representative bodies. It inculcates patriotism of the highest form and makes jobbery in legislation well-nigh impossible.

In the cantons or counties of Switzerland the number of signatures on a petition necessary to compel a measure being submitted to a vote of the people varies from 500 in Zug to 6,000 in Vaud. All these petitions are limited as to time, after the publication of an act passed by the legislative body. The time for the filing of a petition varies from four to six weeks. If the assembly is doubtful as to how a proposed piece of legislation will be received, it may itself refer the given act to a vote of the people.

The initiative, or origination of proposed legislation by the people, has also been successfully tried in Switzerland. This is a kind of legalized extension of the ancient right of petition, wherein the demands of the petition are not discretionary but mandatory. The number of persons who may present a demand for the consideration of proposed legislation varies from a single person in Zurich to 12,000 in Bern. It would seem likely that where any single individual could alone compel a plebiscite or referendum vote on any proposition, there would be a deluge of such demands. But in the twenty years following the adoption of this plan in Zurich, only twenty-two such demands were made and fifteen were rejected by the majority vote of the people.

The constitutional law of Switzerland provides that petitions to the number required may compel a vote even for the dissolution of the assembly and council, the council of seven members being practically the same as the president and cabinet of the United States.

GENEVA AND ITS LAKE

The water front of the beautiful Swiss city of Geneva, which faces the lake of the same name, offers one of the most picturesque views to be found in interior Europe. Geneva is a city of 30,000 inhabitants, lying at the foot of the lake, and divided into two parts by the swift and rushing River Rhone. The favorite promenade, the Mont Blanc Bridge, crosses the river and connects the two parts of the city. Broad quays lined with handsome buildings, many of which are the popular tourist hotels, face the river and lake. A wooded park and a sea wall of masonry are favored resorts for the traveler, who from here obtains a beautiful view of Mont Blanc and the lake itself. Considerable commerce is transacted on the blue waters of the lake, and the peculiarly-rigged sailing boats which ply between the city and the neighboring villages on the shore help to enliven the scene. Here it was that Calvin preached and Rousseau was born. Voltaire, Byron, Goethe and the Empress Josephine were among those whose fame is identified with this favored place of their residence. The lake is the largest in Switzerland, being about fifty by nine miles and 1,230 feet above the sea level. It is in the form of a half moon. The water is deep blue and contains but few fish. It never freezes over and has mysterious rises and falls, strong currents and water spouts. Excellent steamboats serve to carry the traveler back and forth throughout the length of the lake, and give access thus to some of the most delightful resorts of Switzerland.

WATER FRONT OF THE CITY OF GENEVA, LAKE GENEVA, SWITZERLAND.

THE VATICAN

The Vatican, which is one of the seven hills of old Rome, has always retained its ancient name, and in the ages when the papal power was at its height, this name was almost as significant and imposing to the Christian world as that of Rome itself had been to the Pagan nations. The excommunications and anathemas—"the thunders of the Vatican"—made emperors and kings tremble on their thrones, and often shook Europe from one end to the other. Princes and people looked with equal awe to the ecclesiastical palace on the hill, where spiritual arms, with the cross, the signet-ring, and the pen, wielded by a few infirm old men, decided the fate of "powers and dominions." After a long waning, the mighty temporal strength of the Vatican disappeared, but still that immortal hill has a lasting hold on the veneration of mankind.

The palace of the Vatican, which covers a good part of the hill, has few external features to recommend it to the lover of architecture, but taken as a mass, its prodigious size and solidity are imposing. It occupies a space which is 1,200 feet in length, and about 1,000 feet in breadth. It is, however, rather an assemblage of buildings grouped and connected together, than one palace, and the component parts have been erected at different periods, and by very different architects.

Although the building itself has not much architectural beauty, its grand and capital accessory has a great deal. This is the staircase which forms the principal entrance, and connects the Vatican with the noble portico of St. Peter's. It springs boldly from the base of the equestrian statue of Constantine, and in four majestic flights of marble steps, adorned with a double row of Ionic pillars, it reaches the threshold of the grand entrance hall. It is the work of Bernini, and taken altogether it is probably the most magnificent staircase in the world. From the entrance hall we may pass directly into many historic and magnificent rooms.

The history of the Bible, from the crea-

IN THE VATICAN GARDENS.

tion of the world, is painted on the arched ceilings of Raphael's galleries. From one of these galleries a door opens into the Camere di Raffaello, which are covered with the frescoes of that greatest of masters. These rooms in themselves present a great and wonderful school of painting. They are totally unfurnished—the cabinet-maker and the upholsterer had no dustry in Catalonia employs 10,000 persons, each of whom in the course of a year gathers an average of a ton of cork. Where it is so abundant, it is in almost universal use. In Spain, it is made into all sorts of culinary utensils, it lines floors and walks, it is made into mattings of various kinds, and even used as pillows. In Italy, it is made into crosses, images and sandals. In Turkey, where the cork is of a harder quality, it is used in making cabins and is in common use to make coffins for the peasants. In Algeria and Morocco, it affords the material for house furniture, plates, drinking vessels, tubs, armor plating and boats.

THE FAMED STAIRS OF CAPRI, ITALY.

In Portugal there are 34,000 square miles of cork groves. As these forests are in the hands of private monopolies, the government furnishes no statistics. However, it is known that the export of cork from Portugal amounts to an annual average of about 25,000 tons of the rough bark, and nearly 3,000 tons of manufactured articles.

GIBRALTAR

Gibraltar proper occupies a bold, rocky peninsula which guards the passage between the Atlantic Ocean and the Mediterranean. It is a favorite military and naval station, wherein officers of both services can resign for the season their professional cares for lighter joys. Its works of defense, its bomb-proof batteries and fortresses, heavily armed, more resemble the bulwarks of nature than those by the hand of man. They are well grouped together, even if in a small area, because Gibraltar in no case exceeds three-quarters of a mile in breadth. The rock rises abruptly from the low, sandy, peninsula-like isthmus, to about 1,400 feet above the level of the sea. From its summit a view of unique sublimity is obtained. It can only be appreciated when seen. The mighty Mediterranean Sea stretches away in the background, alike shadowy and grand in scenic beauty, steamers and shipping ever traversing its waters. In another direction the Atlantic Ocean and expanded water of the Bay of

Biscay, washing the shores of Spain, are prominent features.

Gibraltar was known to the Greeks and Romans as Calpe or Abyla. The strip of land near Ceuta, across the straits, was named Abyla. For many centuries they formed the renowned pillars of Hercules, the then limit of ocean enterprise and commerce. Its strategical value to England is of paramount importance, being really the key of the Mediterranean, along which the merchants of the world pass upon their lawful commerce.

The ocean's surfy, slow, deep, mellow voice, full of awe and mystery, breaks night and day against the rocks, moaning, as it were, over the dead it holds in its bosom, for the sea is the largest of all cemeteries, and its slumberers sleep without monuments. In other graveyards distinction is shown between the grave of the peer and that of the peasant, but in the sea and ocean, closely encircling Gibraltar, the same waves roll over all, and the same requiem is by the minstrelsy of the ocean sung in their honor. The same storm beats, and the same sun shines over their remains, but their graves are unmarked.

It is the general and popular belief that Gibraltar is an impregnable fortress, but grave doubts have arisen during the last twenty-five years as to whether "The Rock" is really the impenetrable quadrilateral it is generally supposed to be. All political parties of England appear to be agreed that if there are any defects they should be rectified, hence the action of the government in sending out the Duke of Cambridge to inspect and report upon the necessary requirements, the absolute necessary strength of the garrison, and other material and detailed matter.

Gibraltar has been the theatre of many sieges. The first appears to have taken place in 1309, when Alonzo Perez de Guzman took possession of it for Ferdinand IV. of Spain. The real value of the Rock was evidently discovered and appreciated by the Moors in the eighth century, when they erected a fortress upon it. In 1315 there was a second siege, but the invaders were beaten off; however, in **1333 Vasco** Perez lost Gibraltar. A fourth siege to get it back took place in vain in 1344, and in 1349 there was a fifth siege. The sixth resulted in Gibraltar being transferred from the hands of the king of Morocco to those of Yussef III. of Grenada. The seventh siege by the Spanish Count Niebla Enrico de Guzman was disastrous to the besiegers. In 1462 an eighth siege brought Gibraltar once more under Christian rule. By a ninth siege the Duke of Medina Sidonia contrived to get himself, son and heir, created perpetual governors of the Rock. In 1501 the fortress was formally incorporated with the domains of the crown of Spain, and there was a tenth siege in 1506, by the Duke Don Juan, trying to recover possession.

The pirates of Algiers made a furious attack on the Rock in 1540, the object being to recover it for Mahomet, but the besiegers were repulsed after a bitter conflict, and immediate steps were taken to strengthen the works of nature by those of art, so that the Rock eventually became a model first-class fortress. During the war of the Spanish succession, the combined Dutch and English fleets under Sir George Rook captured the fortress. In 1704 Spain closely invested Gibraltar both by sea and land, but after a bitter six months' siege the invaders retired. The apes of Bar-

[illegible]

THE ISLAND OF CRETE

[illegible]

[illegible] quieted matters for a time, but in [illegible]

[illegible]

THE STRANGE SEA MILLS OF CEPHALONIA IN GREECE

[illegible] water regularly flows [illegible] the interior of the land without [illegible]. This strange [illegible] may seem at first sight a reversal of the laws of nature, may be observed at various points on the coast of [illegible], and especially on the coasts of Greece and the neighboring islands. Near Argostoli, a commercial town in the island of Cephalonia, four little torrents of sea water, rolling on an average fifty-five gallons of water per second, penetrate into the fissures of the cliffs, flow rapidly among the blocks that are scattered over the rocky bed, and gradually disappear in the crevices of the soil.

Two of these water courses are sufficiently powerful to turn throughout the year the wheels of two mills constructed by an enterprising Englishman. Though the subterranean cavities of Argostoli are in constant communication with the sea, and the entrance to the canals is carefully freed from the seaweed that could obstruct the passage, or at least retard the current, the waters are not the same height in the grottoes as in the neighboring gulf. This is because the calcareous rocks of Cephalonia, dried on the surface by the sea breeze and the heat of the sun, are pierced and cracked throughout by innumerable crevices, which are so many flues aiding the circulation of the air and the evaporation of the hidden moisture.

The boundaries of this influx have never been definitely determined, but it certainly extends along the coast for nearly half a mile. At all points between the two mills, and for an unknown distance beyond each, the water is everywhere percolating through the cracks and fissures of the limestone and sinking into the earth. The openings in the sea bottom around the point are, no doubt, mainly closed by weeds, gravel, etc., yet no inconsiderable amount of water must find its way to these mysterious depths through such an extent of beach, lying on a rock that is practically as porous as a sieve; and since this condition may prevail for a long distance from the shore, where the pressure would tend to increase the flow, we may reasonably assume the quantity of water absorbed outside of the mills as undoubtedly greater than that needed to run them.

If we assume that each grist mill would require five horse power to operate it, and that the head of water actually used was about three feet, we must have a flow of at least 1,000 cubic feet per minute, or 2,000 per minute for the two mills; and we must double this amount to get even an approximate estimate of the magnitude of the inverted river at Argostoli. This assumption makes the daily consumption of water nearly 6,000,000 and the annual consumption over 2,000,000,000 cubic feet. If we imagine a cavern below we must give it generous proportions, as 2,000,000,000 cubic feet of water would fill a chamber about five miles long, 1,000 feet wide, and

ITALIAN FIELD LABORERS AT THE DINNER HOUR.

75 feet deep. Or, if the water runs into a fissure, say 10 feet wide, it must be about 10 miles long and 4,000 feet deep to hold one year's influx at this point.

No explanation of this phenomenon heretofore suggested is even measurably satisfactory. It cannot be connected in any way with tidal phenomena, because this part of the Mediterranean is almost tideless, and there is nothing periodic in the flow of the water into the land. That the water is simply filling a system of fissures and caverns in the earth is clearly inadmissible in view of the well-established facts. The flow of water into the land has certainly been uninterrupted since 1833. The supply of water is exhaustless, and the rate of downpour is limited only by the capacity of the fissures. The present rate of flow, or anything approaching it, continued for a century, would give a total volume of water so prodigious as to far exceed the capacity of any known caverns.

The force of this objection is augmented by the consideration that caverns other than fissures must have been formed by solution of the rocks and have thus required for their formation a volume of water many times greater than that required to fill them. Furthermore, it is virtually an axiom in geology that all cavities in the earth below the drainage level of the district, and especially below sea level, except possibly those due to recent, sudden, and extreme rifting, must be permanently and continuously full of water, and certainly it is hardly conceivable that fracture fissures, developed at the surface as mere cracks, could require centuries for their filling with the sea pouring into them.

None of the suggested modifications of the cavern theory seems to be worthy of serious consideration. We cannot suppose that the water flows into caverns and disappears by evaporation or absorption. Both of these processes below a very moderate depth would necessarily be extremely slow, and the former would gradually fill the caverns with salt. Nor can we follow the supposition that an earthquake has at some period opened a communication between the sea and the region of volcanic fire, and that the water, being there converted into steam, is afterward condensed in its upward course and forms those hot springs which exist in various parts of Greece.

Equally objectionable is the view that the water is absorbed at great depths by molten masses. Volcanic phenomena are wholly wanting in this part of Greece; that is, there are no active, recently active, or extinct volcanoes, nor, so far as we can learn, any geologically recent volcanic rocks. The great crater of Santorin is three hundred miles distant, while Cephalonia and the neighboring mainland consist of secondary and tertiary strata, overlying ancient crystalline rocks.

The rejection of all these hypotheses forces us to the conclusion that in some way the water must return to the surface. A circulation, due exclusively to hydrostatic pressure, is manifestly impossible, unless, indeed, it should issue in the basin of the Dead Sea, a full thousand miles distant, since the water starts downward from the sea level. Still less can we suppose that it would rise in the form of saline springs on the land.

It has occurred to mind, however, that in the subterranean heat we have an adequate cause of aqueous circulation. The temperature of the ground increases downward, and it certainly is not a violent hypothesis that the water gains access to a system of fissures traversing a notable range of temperature. In this connection it may be noted that the conditions are favorable to profound fissuring; for Cephalonia, like the rest of Greece, is distinctly a seismic region—earthquakes, often of destructive severity, being of annual and almost monthly occurrence, and the prevailing rock formation is the massive cretaceous limestone, some thousands of feet in thickness.

LIFE IN A TURKISH HAREM

Romance, mystery and pictures of revolting moral misery have been almost the sole source of information regarding the peculiar home life of the people whom we chiefly know as the unspeakable Turk.

Our own customs are, of course, our own measures of morality, and anything different must be very bad. However, if it is enough to live a satisfied life, we must admit that the inmates of the harem live well. They are wholly absorbed, as nuns in a convent in the child-like faith and religious sentiment of their career. Strange to say, more than ninety-five per cent of the inmates of the harems of the rich and powerful are Circassians. These white women of Circassia look upon an entrance into a Turkish harem as the height of ambition. In truth, it is a great advance to them, both socially and materially. They believe themselves far superior in caste to any Christian lady that ever lived. The Circassian is first a slave in the harem, but at any time she may become the wife of the master and thus be raised to such superiority over others that the slave is always treated with as much deference and respect as if she were already mistress of the house.

It causes no comment for the wife of a rich pacha to rise on the entrance of a slave and humbly kiss her hand. This is because the wife was once in an inferior position to what the slave now is, and had always been well treated by the slave thus honored. As an inferior slave may suddenly be raised to high position, her former superiors kiss the hem of her garment without jealousy or envy, for to them it is all fate.

The great national powers, by compact with the Turkish government, forbade the traffic in slaves a few years ago, and since

CONSTANTINOPLE—YILDIZ PALACE AND MOSQUE.

then the number of Circassians in the harem has somewhat lessened. Before this, when a young man became twenty years of age, his father went to the slave market and brought home a few slaves, from which the son selected a wife. Then the young man in the course of the year bought two or three more as slaves of his wife. These, with the wife, were in the same position as the slaves of the father. At the death of the father, his wives went out of the house to homes of their own, with their children, and the son's wife became the head of the house, while her slaves became odalisques, that is inferior wives.

The odalisques rank much lower than their children in the household, but higher than their slaves. Should they have no children, or should their children die, they rank no higher than slaves, and can expect no different treatment. In that case, at the death of their husband, they are either pensioned, on barely enough to keep them, or they are married to any old servant who will keep them, or they are sold as slaves and begin again the life of a slave, with its prospects.

The entire life of the odalisque is spent in sewing, gossiping with her slaves and visitors, and caring for her children. The house of the harem has its walled gardens

THE FAVORITE OF THE HAREM.

and yards, and of warm evenings the family gathers in a group on the grass under the trees, sing songs and listen to the wild stories of some old woman. These evening scenes may be visited by the brothers, cousins, nephews or uncles of the head of the family, but by no others.

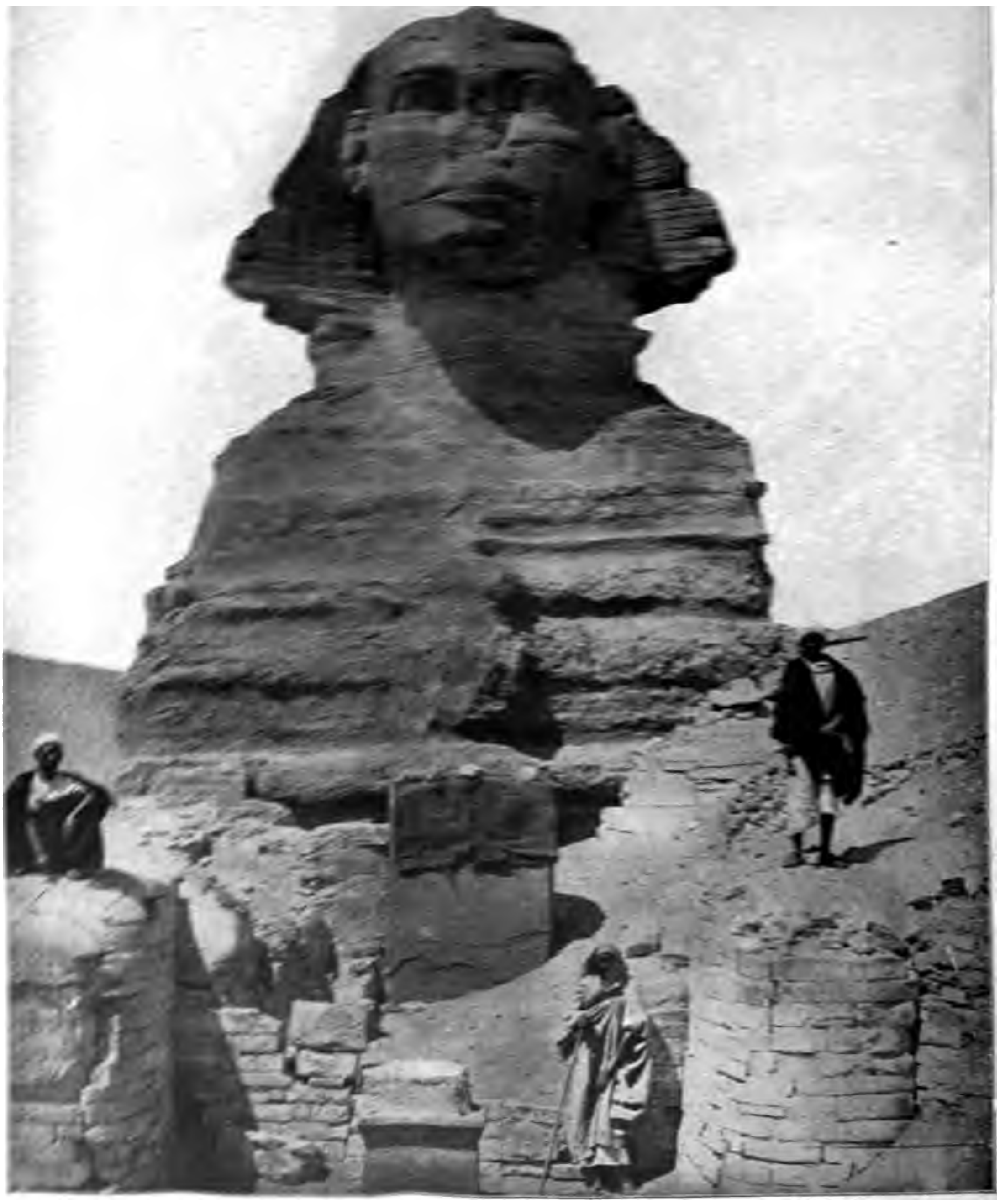
The fidelity of slaves to the odalisque is a remarkably developed trait. "I have eaten her bread and salt and I can not leave her," is the sentiment expressed. Bread and salt are sacred symbols, and no greater curse can be pronounced in a household than for the master to say, "May my bread and salt rise against you."

EGYPT AS IT IS TO-DAY

Great as it was in the early history of civilization, Egypt to-day has but little prominence in the affairs of the world. Even now its chief interest to us lies in the past. Luxor, Karnac, Memphis, the Nile, the Pyramids, the Sphinx and the Desert —these are the names that are significant to us in their suggestion of a historic past and a proud civilization. And yet even in Egypt the influence of the Industrial Age is felt and a new regime seems to be beginning. To-day, Alexandria, the ancient city, is an important modern port, largely rebuilt since the bombardment, twenty years ago, and the center of a large export and import trade. The Suez Canal turned the tide of travel between the Orient and the Occident across the corner of this ancient realm, where the Red Sea and the Mediterranean come nearest together. This has brought hosts of travelers into Egypt whose journeys otherwise would have taken the wide detour from Europe around South Africa, to reach India, Australia or the Far East.

Here is another evidence of the far-reaching effect of the industrial influence upon whatever country it touches. The construction of the Suez Canal made it necessary that the European Powers, who shared in its expense and whose vessels made use of it, should preserve the peace and order of the neighboring country. And so first by formal treaty and afterward by virtual occupation, England obtained dominance in the affairs of Egypt, which is nominally a state tributary to Turkey, and governed by its own Khedive. The Turkish influence, therefore, being virtually nullified in Egypt, and the British influ-


IN THE SHADOW OF THE GREAT PYRAMID.



THE GREAT SPHINX, NEAR THE PYRAMIDS, CAIRO, EGYPT.

ence having become so strong, Egypt is enjoying peace, order, commercial prosperity and industrial development to a degree that it has never known before. Modern innovations have been introduced into the Egyptian cities almost as freely as in Western Europe. It is not necessary now to patronize the clamorous donkey boys to reach the ancient remains of the tombs of the Pharaohs, for an electric trolley line speeds the stranger, from Cairo swiftly across the desert to the very base of the Sphinx and the great pyramids themselves. It is not yet reported that an elevator is running to the top of the pyramid of Cheops, but we do not know what may happen. Passenger steamers ply up and down the Nile, and the products of that fertile valley, still irrigated by the annual overflow, as it was 5,000 years ago, enter the markets of Europe in competition with our own wheat, corn and cotton. Railways extend far southward along the Nile, into the heart of the continent, and it is no longer to be doubted that within a few years there will be direct connection from North to South Africa by way of the Cape to Cairo Railway.

EGYPTIAN VILLAGE ON THE UPPER NILE.

CAMEL RACE IN SOUTHERN EGYPT.

RECENT DISCOVERIES IN EGYPTIAN ANTIQUITIES

It is difficult to realize that only five or six years ago criticism, so-called, was still assuring us that Menes, the founder of the united monarchy of Egypt, and his immediate ancestors were "mythical" and "fabulous." Now we know almost as much about them and the people over whom they ruled as we do about the Pharaohs of the fourth dynasty. Art was far advanced; the system of hieroglyphic writing had long since been perfected, and a "hieratic" or running hand had even been formed out of it. The jeweler's art had already reached a high state of perfection; a gold cylinder of a Babylonian type has been found by Dr. Reisner with the name of Aha, or Menes, upon it, and in one of the Abydos tombs four exquisitely wrought bracelets have been brought to light, the alternating gold and turquoise plaques of one of which are inscribed with the same name. The tombs themselves are vast and stately structures, more especially that of Den, or Esaphaes, which was paved with huge slabs of granite from Assuan.

Intercourse must have been carried on with all parts of the known world. The gold, which contains a little silver, came, according to Dr. Gladstone's analysis, from Asia Minor; the vases of obsidian, fragments of which have been found in the tomb of Menes himself, from the Island of Melos in the Aegean Sea. There are shells from the Red Sea, and indications of the use of the incense that was brought from southern Arabia, and the coast of Somaliland, while the seal cylinder and the employment of clay as a writing material imply Babylonian influence. Indeed, the beads of lapis-lazuli which help to form one of the bracelets may have been imported from the mountains of Persia.

Egypt was thus already connected with the rest of the civilized world both by land and by sea. A few miles to the north of Abydos, near the village of Mahasna, the great brick tombs of two of the earliest kings of the third dynasty have been discovered by Mr. Garstang. The largest of

[illegible] CHEOPS OR GREAT PYRAMID, NEAR CAIRO, EGYPT.

[illegible] height. Built [illegible] B. C., requiring the labor of 100,000 [illegible] years. Was the tomb of Cheops, an Egyptian Monarch.

them is thirty feet above the surface of the ground and nearly seventy feet below it. The eighteen chambers which the explorer discovered here are approached by an arched passage and staircase which runs down through the middle of the edifice, from its top to its bottom. Huge portcullises of granite, let down from the openings in the brick roof, close the passage and cut off the approach to the chambers. The sepulcher is what an old English writer would have called "magnifical," and testifies to a fact which is being impressed upon us by other recent discoveries, that the greatest architectural works of Egypt belong to what has hitherto been regarded as the beginning of its history. There is no longer any reason to question the Greek record that Menes diverted the Nile from its former channel under the Libyan hills, by means of a dike which Mariette identified with that of Koshesha.

BAKING BREAD FOR THE BRITISH ARMY ON THE NILE, UPPER EGYPT.

THE GREAT PYRAMIDS OF EGYPT

The Pyramids of Gizeh are all that remain of any of the Seven Wonders of the Ancient World and they were old before any of the others had been thought of. In the time of Moses they were already ancient monuments, old almost beyond any of the authentic traditions of the times. They even then belonged to the times of an Ancient Egypt. Ever since the Israelites were in bondage to the Pharaohs, the minds of curious investigators have been busy with speculation as to why they were ever erected. Within the last century the

[illegible]

[illegible] of [illegible] as a com- [illegible] of certain [illegible] mem- [illegible] The latter is now [illegible] theory. A [illegible] farther back [illegible] them as the [illegible] Pliny, who died in

THE SLAVE MARKET IN MOROCCO.

bodying in imperishable stone the mathematical and religious symbols of the world, as a measure of planetary distances, as a permanent standard of weights and measures, as monuments to monotheism, as prophecies of the birth of Christ, as a mathematical prophecy of the Second Advent measuring in numbers of inches the year 1882, as a record of their latitude, longitude, and date of beginning construction, as vast sundials used to note the prog-

the first century of the Christian era, says that there were traditions in his day which attributed their construction to the desire of certain kings not to leave any money to their successors, and also that it was the theory of the learned men of his time that they were built merely to use up the surplus energy of the people and to keep them employed. Many learned archaeologists still hold to the latter theory. Plato and Aristotle both held this theory.

Herodotus, born 484 years before Christ, carefully examined the pyramids and gave the theory almost unanimously approved by modern scholarship, that they were built as the tombs for the kings of reigning dynasties. At the time of Herodotus there remained enough of the causeways or embankments upon which as inclined planes the great stones were dragged on rollers to their places, that Herodotus was able to put on record the method by which the pyramids were built, otherwise that process would now be as much a mystery as the purpose of these vast stone structures. Herodotus regarded these great causeways as objects of wonder almost equal to the pyramids themselves. According to his story there yet remained parts of these causeways in some places sixty feet wide and fifty feet in height. At that time the whole surface of the pyramids was covered with casings of cement, upon which were engraved or impressed hieroglyphics, giving these vast structures the appearance of having been chiseled smooth out of a single mountain of stone.

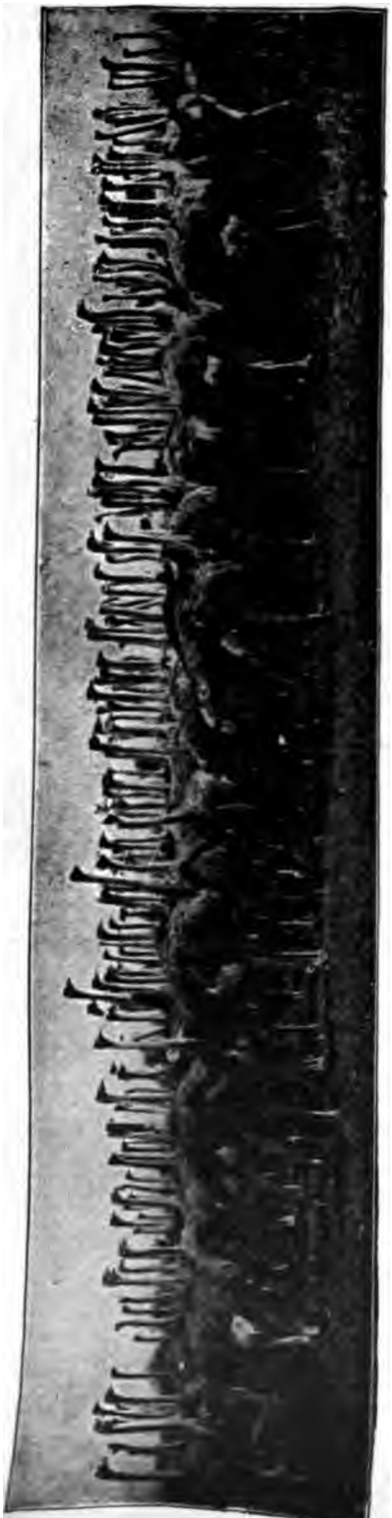
Thus is the idea suggested that perhaps the monuments were not only designed as the tombs of dynasties of kings but that the outside surface was designed to be a great library of history, or perhaps tablets for the engrossing of the law.

A French pilgrim to Egypt in 1395 found the dismantling of Cheops only about half done, and as late as 1638 most of the casing on Khafra Pyramid was yet untouched. An Arabian writer of the thirteenth century says that if the inscriptions on these casings were copied they would fill more than ten thousand pages. But these have all disappeared because of the ignorant vandalism of the Egyptian governments of the middle ages, excepting a few inscriptions copied by early pilgrims. Thus perished what might have been a complete history of the civilized world for unknown periods that were centuries prior to the birth of Moses.

THE TROGLODYTES OF AFRICA

The Troglodytes, or cliff and cave dwellers, of Africa are in the line of caravan travel, and are visited by these freight trains of the African desert. No outside influence has been able, however, to wean them from their ancient habits, their antique garb and their peculiar manner of living. So far as is known, the manners and customs of the Troglodytes have not changed since Bible times, and any one coming upon a group of these people in the present day, and comparing their appearance with descriptions extant that some historians have regarded as fabulous, will see that they are precisely the same now as they were many centuries ago.

A Troglodyte city is the most curious dwelling place in the world. From the exterior it presents the aspect of a Roman circus. The habitations are built in layers one above the other, and form a circular wall with a single entrance from the outside. All the doors of the houses open on the interior of the circular city. Each habitation has a door and a window. To get to them you climb a flight of steps cut in the wall, which brings you to the lower layer of houses. If you wish to go higher you climb another pair of steps to the houses above, and from here to the third row, if you are visiting some one living on the top of the pile. The doors are all fas-


OSTRICHES IN SOUTH AFRICA. ONE YEAR'S CROP ON A LARGE FARM.

acceptance of all sorts of traditions and travelers' tales that circulated from mouth to mouth very freely. Even the stories of Gullivers travels, with his dwarfs and giants and talking horses, found believers, where, on the other hand, the stories of Marco Polo, Sir John Mandeville, and other earliest travelers to the Orient, who reported things which are now known to be mostly true, were hardly believed at all.

Strangely enough, there are discoveries made at times, with the advance of exploration in the present day, which go far to verify some of the most extravagant stories of the past. Africa has done much to justify some of these old-fashioned myths. In Africa, for instance, was found the rhinoceros, which, with its single horn, is a clumsy sort of substitute for the unicorn of the ancients. In Africa, too, have been discovered races of man extremely backward in their development, and at least two tribes which are actual pygmies, to justify the old stories of the country of the dwarfs. It is in the great forests of the Congo River in Central Africa that these most peculiar races have been found. These pygmies were probably well known to the ancient Egyptian slave-traders, who journeyed up the Nile in ancient days to return with treasures and curious specimens and wonderful stories. Herodotus wrote about the pygmies and their fights with cranes, but the story has been believed entirely mythological, until the discovery of ostriches and these very dwarfs has given justification to the ancient classic writer. Sir Harry H. Johnston, the governor of British East Africa, who has described these African tribes most interestingly, suggests that from the mischievous actions of such dwarfs as these may easily have come the stories of brownies and goblins in our own fairy tales. He found two varieties of the pygmies, one with reddish and yellowish brown skin and a tendency to red in the hair of the head, and the other a black-skinned type with entirely black hair. The latter are slightly taller than the others. The tallest specimen measured by the explorer was about five feet in height, but the average height for the man was four feet, seven inches, and for the woman four feet, two inches. Several of the men were only four feet, tw inches in height, and several of the women were four feet. The nose and the lips are very different in shape from those of the ordinary negro types, the upper lip being long and straight and the nose having very little bridge. The chin is very much receding, the neck is short, and the head rather sunk between the shoulders. The legs are short in proportion to the body and the feet are inclined to turn in. Some of the dwarfs have quite long beards. They seldom wear anything in the way of ornament and in the forests they go about naked.

These Congo pygmies are very shy, and avoid contact with travelers through their country. They keep no domestic animals nor do they cultivate the ground, but live entirely by hunting with bows and arrows or snares. Their huts are about four feet high and of about the same diameter, built of branches stuck into the ground and bent over into a semicircle. The hut is thatched with large leaves and a small hole is left at the side through which the pygmy crawls in to lie on his bed of leaves, which is the only piece of furniture.

Stanley found some of these dwarfs in his journey through the Congo forests, and agrees with Sir Harry Johnston in the description. It seems that the little fellows have no language of their own, but talk more or less imperfectly the language of whatever tribe of negroes happens to be their nearest neighbors. The white travelers who have visited them say that, although they are absolutely savage in their natural life, yet they possess quicker intelligence than the ordinary negroes and learn languages easier. The foreign travelers declare that they are most interesting people, fond of singing and dancing, with music of their own that is distinctly melodious, and a drollery of action which makes them generally entertaining. It remains now for Africa to yield a race of giants to complete the record of marvels which the continent has produced.

WHO ARE THE BOERS?

The Dutch were not in the first instance the discoverers of the Cape of Good Hope. The old Portuguese navigators were the first to brave the terrors of the Stormy Cape, as they called it. In 1486 Bartholomew Diaz doubled the Cape, and pushed his way beyond the present site of Port Elizabeth. In 1497 that great sailor, Vasco da Gama, passed the Cape, and penetrated by sea as far to the eastward as the Mozambique coast. Although the early navigators occasionally touched at the Cape on their way to the Indies, there seems to have been no regular settlement there until well into the seventeenth century. In 1591 Captain James Lancaster, with an English squadron, visited Table Bay. In 1595 four Dutch vessels, the first fleet to cast anchor in these waters, touched at Mossel Bay, a little to the east of the Cape. From this time fleets of the various nations were in the habit of calling at the Cape of Good Hope for rest and refreshment, obtaining oxen and sheep from the Hottentot aboriginals, and picking up wild fowl, fish and green herbage.

In 1652 the Dutch East India Company finally took possession of the Cape, and founded a settlement there. Jan Van Riebeek landed with a number of colonists, and at once set vigorously to work to establish the foundations of Dutch supremacy in this quarter of the globe.

[illegible]

[illegible] IN THEIR OWN COUNTRY

[illegible]

[illegible] ... at a time through the same shaft. [illegible] ingenious method of mining, every portion of the ground is [illegible] and raised to the surface, the rubbish [illegible] the top gradually sinking down and taking its place. The scene below ground in the labyrinth of galleries is bewildering in its complexity, and is about as little like one's idea of a diamond mine as can well be conceived. Electric light is universal in the workings. One set of workers attends to the rock-drilling machines for blasting the blue ground; in other parts the blue is shoveled into wagons, which, when filled, are carried along rails by moving ropes till they get to the gallery, where the contents are sent to the surface.

At the bottom of the main shaft, at the 1,300-foot level, the galleries converge to a large open space where the tram lines carrying the trucks meet. In front is a chute to which the trucks full of blue ground are rapidly wheeled, tipped over and their contents discharged, when they are shunted to make way for other trucks. At the foot of the shoot is a "skip" holding 64 cubic feet, or four truck loads, an electric bell sounds at the engine-house, when the skip is hoisted to the surface and another takes its place. So the work proceeds, and on busy days ground has been hoisted at the rate of 20 loads every three minutes, equal to 400 loads an hour. In 1894 the record hoisting of blue ground at the Kimberley mine was 470 loads an hour; in one shift of eight hours 3,312 loads, and in a day of three shifts, 7,415 loads.

All below ground is dirty, muddy, grimy; half naked men, black as ebony, muscular as athletes, with perspiration oozing from every pore, are seen in every direction, hammering, picking, shoveling, wheeling the trucks to and fro, keeping up a weird chant, which rises in force and melody when a titanic task requires excessive muscular strain. The whole scene is far more suggestive of a coal mine than a diamond mine, and all this mighty organization, this strenuous expenditure of energy, this clever, costly machinery, this ceaseless toil of skilled and black labor, going on day and night, is just to win a few stones wherewith to deck my lady's finger.

The sorting room in the pulsator house is long, narrow and well lighted. Here the rich gravel is brought in wet, a sieveful at a time, and is dumped in a heap on tables covered with iron plates. The tables at one end take the coarsest lumps, next comes the gravel which passed the three-eighths-inch holes, then the next in order, and so on. The first sorting is done by thoroughly trustworthy white men; for here the danger of robbery is greatest. Sweeping the heap of gravel to the right, the sorter scrapes a little of it to the center of the table by means of a flat piece of sheet zinc. With this tool he rapidly passes in review the grains, seizes the diamonds, and puts them into a little tin box in front of him. The stuff is then swept off to the left, and another lot taken, and so on till the sieveful of gravel is exhausted, when another is brought in. The stuff the sorter has passed to his left as temporarily inspected, is taken next to another part of the room, where it is again scrutinized by native convicts again and again, and as long as diamonds can be found in quantity sufficient to repay the cost of convict labor, it is passed under examination.

The diamond has a peculiar luster, and on the sorter's table it is impossible to mistake it for any other stone that may be present. It looks somewhat like clear pieces of gum arabic, with a sort of luster which makes a conspicuous shine among the other stones.

In the pulsator and sorting house most of the native laborers are long-sentence convicts, supplied with food, clothing and medical attendance by the company. These men are necessarily well guarded, and all the white men in the works carry revolvers. Apart from the hopelessness of a successful rising, there is little inducement to revolt; the lot of these diamond workers is preferable to life in the government prisons, and they seem contented.

Sometimes as many as 8,000 carats of diamonds come from the pulsator in one day, representing about $50,000 in value. Prodigious diamonds are not so uncommon as is generally supposed. Diamonds weighing over an ounce (151.5 carats) are not unfrequent at Kimberley, and, were it necessary, there would be no difficulty in getting together a hundred of them.

WIFE OF BEDOUIN CHIEF.

ABYSSINIA AND ITS ANCIENT CHRISTIAN FAITH

Just as very few are familiar with the fact that Egypt was once a Christian kingdom, for 259 years ending A. D. 640, so there are fewer still outside the circle of missionary enterprise, who know or care aught for the existing Christian Empire of Abyssinia, beyond its more recent political records. Yet Abyssinia has been Christian for centuries; and its late King John, who greatly enlarged its boundaries and extended its influence in Central Africa, bore, like some European monarchs, the title of "Defender of the Faith," most dear to the kings of Abyssinia.

The Christian period of Egypt, comparatively short in duration and unimportant in influencing neighboring tribes or communities, ended in the Arab conquest under Amru, which left but few vestiges of Christians or Christianity. To-day, a small Coptic community in Cairo, respected more for the intelligence of its members, the chief accountants and clerks of the administration, than for their numbers or influence, and a few more scattered over various villages, alone attest the antiquity of Christianity in Egypt. But Abyssinia, the ancient Ethiopia, claiming to possess the primitive Christianity and boasting of preserving the relics of St. Mark the Evangelist, has ever held fast to Christianity, even though disfiguring it with strange superstitions, distorting it with fierce fanaticism, and showing even sterner savagery than animated the old Crusaders, with whom hatred to the heathen was equivalent to love of God.

Three great mountain chains forming a triangle, with its base resting on the Abai and the Kawash, and its apex at Massowah on the Red Sea, are the boundaries of an immense elevated plateau, upheaved by volcanic action from the sultry plains of tropical Africa, but blessed with a climate as fresh and healthy as any in Europe. Indeed, the table-lands of Abyssinia, bounded on the north and west by the arid deserts of the Sudan, on the south by the country of the ferocious Gallas, and on the east by Debeni, Adal, and the great salt plains of Arrhoo, may be likened to some rocky island rising in the midst of the ocean, rich with verdant plains, bubbling streams and shady woods, but seldom visited by the mariner, owing to its isolated position and the terrible cliffs by which it is surrounded. Very seldom do the natives of the Abyssinian plateau venture down into the fever-stricken plains, where dwell their hereditary enemies, the Mahometans and the pagan Gallas. Nor, except when led to a profitable and pious invasion of "Habash," do the people of the low countries often penetrate the wild passes of the Abyssinian mountains. It happens, therefore, that from whichever side the traveler approaches Abyssinia, he can glean but little information from the natives, concerning the country beyond the mighty wall of mountains which rise before him, as if to bar his path

The Abyssinians trace the origin of thei empire to the days of Solomon and the Queen of Sheba's visit to him; and their line of kings to the joint issue of those two potentates. Their religion exhibits a strange mixture of Judaism and Christianity; a great pride of race and religion animates this singular people whose monarch bears the haughty title of "King of Kings";

AN ARAB SCHOOL.

and they consider themselves not only the peers, but even the superiors, of all the rest of mankind.

It was the English expedition against King Theodorus, in 1867, that opened out the country and let in some light on its dark places. Great was the surprise of

IN AN ARABIAN OASIS—THE EVENING CAMP.

Christendom, which had previously classed the Abyssinians among other savage and warring tribes, leading a nomadic existence in the deserts and jungles of Africa, where the climate and wild beasts dispute with equally savage men the entrance or egress of the foreigner and repel the onward march of civilization. Since then they have defeated Italy in a disastrous campaign, undertaken to claim them as a colony.

THE RAILWAY RACE FOR THE INDIAN OCEAN

The greater European Powers have entered upon a remarkable race for trade and influence in the Orient. The remarkable products and the enormous commerce of Southern and Eastern Asia are tempting the commercial nations to use all their energy in securing a share of the profit that offers there. Steamships have supplanted sailing vessels in large measure, and now the tendency is toward railway construction. No European Power except Russia connects directly with the Orient by railways included entirely within its own territory, and inasmuch as the Russians have seized their opportunity by building from Europe to the Pacific Ocean with a branch through Manchuria, the rival Powers are even more anxious to support their own interests in similar fashion as far as possible.

Persia and Turkey each offer natural routes by which communication can be established from Europe to the Indian Ocean by combined railway and steamship lines. Persia, once in ancient times the most powerful of nations, with Cyrus, Darius and Xerxes as its greatest rulers, is at last falling under the influence of the advance of western civilization and yielding to the pressure of European inducements. Germany, England and Russia are all centering their attention on it with jealous eyes, each endeavoring to preserve Persian trade and Persian concessions to the exclusion of the others. Turkey likewise is the subject of constant pressure from more than one of the great western Powers, in the effort to obtain the same privileges. Comparatively short railway lines across Turkey from the Mediterranean or the Black Sea, or across Persia from the Caspian Sea, will connect European waters with the Persian Gulf on the south. From this Persian Gulf terminus the voyage is a greatly reduced one to the cities of the Orient and the East. The

MOHAMMEDAN PILGRIMS DRAWING NEAR TO MECCA.

Russians have prosperous steamship lines plying to every port on the Caspian, and except for the south shore, which is Persian, that great body of water, five times as large as Lake Superior, is a Russian lake. Indeed, the northern provinces of Persia itself, bordered by Russian railways in Transcaspia and by Russian steamship routes on the Caspian Sea, are now all but Russian. From Baku, the great petroleum port on the west shore of the Caspian, the railway system is extending southward toward Persia and the Russians apparently will have first access by this route to the Persian Gulf. French, German, Russian, Austrian, Italian and British steamships ply on the Black Sea and the Mediterranean, and of these countries Germany has the lead in railway concessions across Asia Minor to the Persian Gulf. The world is becoming smaller by the multiplication of new railway and steamship routes, and the traveler is profited by the rivalries of the Powers. The coasts of Turkey around the Black Sea and the Mediterranean have been accessible by numerous steamship lines, so that Turkish products and Turkish life have been fairly well known to the outer world. But Persia has been generally out of reach of observation and development.

With the new regime of western trade and western methods introduced, Persia is altering its manners very rapidly. The country is one of large resources, although the beautiful silk and wool fabrics are virtually the only products that are conspicuous in American and European markets. Persian rugs are prized as the choicest floor coverings for the houses of our own people, and Persian silks and shawls likewise are highly valued. They are of the finest quality and highly decorative in design.

DANCING AND HOWLING DERVISHES

There are two kinds of dervishes, the dancing and howling dervishes. The Tekke, where the religious dances of the former are held, in Turkey, is in Kassim Pasha, a village suburb of Constantinople. Also in the Sudan there are numerous sects of dervishes, all with their peculiar customs. There is nothing in the exterior of their buildings to distinguish them from other rather grim and prison-like houses in the long, narrow street of Constantinople. One's attention is drawn to the place by the train of solemn, brown-cloaked figures, wild-eyed and hollow-cheeked, who come toiling up the brow of the dusty hill, and disappear into the building. Weird looking beings they are, with the glint of the maniac in their eyes, but impressive and dignified in spite of their ludicrous dress.

The inside of the Tekke is a large, circular hall, with a highly polished marble floor and a promenade, for men only, round the dancing portion of it on the ground floor. A row of white marble pillars and a low marble screen separate the spectators from the dancers. Christian ladies present are taken up into the balcony. The division of the balcony, which is not screened off, is reserved for strangers of both sexes. Being Christians, it is not deemed necessary for the ladies to sit alone or behind the arabesqued grille.

A visitor describes one of these scenes as follows:

"It was weary work waiting for the dancing to begin. The orchestra had been playing with all its might, in a small division of the balcony entirely hidden from sight, music that until then I thought only a Chinese band at a joss-house meeting could produce. It was the sort of noise that makes one's teeth ache, shrill whistles and queer stringed instruments of every shape and variety, positively shrieking out inspiration to the dancers. The noise was barbaric, and cannot be imagined by an ear unaccustomed to Eastern music. While this awful music was drumming itself into my brain and nerves, the dervishes were walking in solemn procession around the room. Their curious dress is made of thick, soft, sand-colored felt, and their high hats reminded me of a pailful of sand turned out on the seashore. When the figure is not in motion, the skirt hangs in soft, close folds, reaching to the ankle, and when the dancer is spinning round and round like a teetotum it flies out into a complete circle, getting larger as the motion increases in rapidity. A dancer with accordion pleats could hardly do more. A dervish of high position sits in a sort of throne, raised on a low dais at the east end of the building. When the dancers, who walked round the building with their arms folded across their breasts, reached his throne, they bowed low, facing Meccaward, and passed out of his presence backward. This solemn walking and endless bowing seemed to last an hour and a half, the rasping orchestra doing its best to work up their feelings to the necessary pitch of excitement.

"Quite suddenly it had the desired effect, for a small figure, one of the youngest of the company, glided silently off the red matting which led up to the dais and commenced the famous dance. Eastern nations seldom move their feet from the floor, and the dervish dancers in this respect are much the same as the Japanese geishas and the Indian nautch dancers; in fact, to the English mind it is not dancing. I had hoped that they would whoop and shout and jump about in a wild corroboree, like the Australian aborigine or the Indian of America, but their dancing is as solemn as their walking. With their arms extended out as straight as possible, they spun round and round the room on their bare feet. The giddiness of the motion became sickening to look at. One after another they glided over the polished floor with their feet close together and their arms extended, until they made the room look full of human pegtops. But the dancing soon became as monotonous as the walking had been, and all that we were waiting for now was to see them drop down in a fainting fit from exhaustion. I watched their faces change from the awful sallowness which is their natural color to a dull red, and from a dull red to a horrible crimson, and then back again to a more ashen hue than before. The different stages of fatigue were horrible to witness. Round and round they went, until the whole room seemed to be revolving on its axle. In my fancy the white marble pillars had left their accustomed place and had joined the wild-eyed figures down below. I felt that it was time to go, and I staggered across the balcony and groped my way down the narrow stair. As we were going out we saw two of the dancers being carried out of the building."

The howling dervishes wait for the inspiration "to howl," while the band plays the same class of music as has been already described, or, if possible, worse. While they are waiting they stand with their backs rigid against the wall of the building and their arms folded across their chests. Softly the "howling" begins. It is only a low moan at first, and very gently the bodies

DEPARTURE OF THE SACRED CARPET FROM CAIRO, FOR MECCA.
Once a year the Khedive sends a beautiful carpet to the tomb of Mohammed, in charge of the Mecca pilgrims. It is hung in the tomb until brought back by the next year's pilgrims, when it is given to some mosque which it is desired to honor.

bend forward from the waist, but the moaning gets louder and louder, the bodies bend further and further forward until their foreheads almost touch the marble floor. Within half an hour's time the howls get fiendish and the gray-robed figures rock themselves back and forward with horrible violence and rapidity. Their balance is marvelous, for they never move their feet or knees. One after another becomes purple in the face, and their wild eyes seem starting out of their heads. Mad yells make your blood run cold, and you do not wait to see the end of the entertainment.

PILGRIMS TO MECCA

Every year thousands upon thousands of pious believers in the name of Mohammed desert their homesteads and wend their way, both by land and by sea, towards the country that saw the birth of their religion and witnessed the miraculous deeds of their archprophet. From China, India and Persia; from every quarter of the Turkish Empire; from Egypt, Tripoli, Tunis, Algiers, and Morocco; from Zanzibar and Senegal; from Kurdistan and Afghanistan; from the Sudan and the great Sahara, and from many other places whose existence we are but dimly conscious of, they throng, many poor, ignorant and dirty, but devout and determined in their purpose. They are pilgrims to the holy cities of Arabia, Mecca and Medina, and to reach them they starve themselves for years to save up sufficient money to defray their expenses, and endure horrible privations by the way. They commit themselves to the mercies of the vast and awe-inspiring sea, dreaded by all true Orientals; they risk being robbed by the Bedouins or killed by the heat, and all with an amount of phlegm and good humor that is almost sublime. Whatever happens to them they care not; God will provide for them, and should they die on their way out they will be received all the more readily into the mansions and the arms of the voluptuous houris already provided for each one of them by their much-beloved prophet in the seven-storied paradise of Islam.

It is incumbent on all good Moslems to perform this pilgrimage at least once, if they can afford it. Many perform it several times, and some make a business of it, and hire themselves out as substitutes for others; for a pilgrimage by proxy is considered to be as effective as one performed in person, provided that the person in whose behalf it is performed be dead. No one can hire a substitute during his lifetime, but he may leave a provision to that effect in his will. This pilgrimage must not be considered in the light of a penance, after which the hadji is to receive a plenary indulgence for past sins. It is an ordinance of the religion of Islam, of the same nature as the Eucharist, whereby the believer is supposed to be brought into closer communion for the time being with the Deity and his human representative.

Of course it is easy enough to declare that one is not able to afford the expense of the undertaking, and many, without the least odium being attached to them, excuse themselves on that plea, for it is expressly ordered that no man unable to pay his own way without being an incumbrance to any one else should attempt it. The necessary expenses vary according to the station of the hadji. A poor man starting from the shores of Persia could perform the whole pilgrimage and get back for about three

hundred and fifty rupees, or about $110. A person of any consequence would probably spend a thousand rupees; and of course a rich man could, if he liked, spend a much larger sum. Yet not much opportunity for display is allowed.

All around Mecca there are certain places, forming a circle round the city, after passing which the pilgrimage begins in earnest. For men no covering is allowed but a couple of white towels or bits of calico sheeting, one fastened round the waist and the other thrown over the shoulder. On women, also, no jewel or ornament of any description is tolerated, robes of snow-white linen constituting their only apparel.

In the present age of increasing facilities in travel, the pilgrimage is made in all the cheapness and comfort desired. The scenes of vast multitudes, reduced to a common level, coming to the tomb of the prophet, are indescribable in their picturesque and motley array. Modern sanitary precaution and discipline have reduced the danger of disease and the terrors of the pilgrimage have been removed. Where formerly the host of pilgrims slept upon a blanket, most of them now come in groups and have tents, thus, during the season, presenting the picture of a vast army encamped on the plains.

MOUNTAINS AND OIL-WELLS OF THE CAUCASUS

Two great petroleum monopolies virtually divide the world's markets between them, one, the Standard Oil Company of the United States, and the other the corporations controlled by the Rothschilds in Europe. Of course there are minor companies with local trade in many countries, but the greatest volume of traffic in petroleum or naphtha and its products is in these hands. In America the oldest and most famous oil fields are those of Pennsylvania and Ohio, although other isolated regions have shared the production. Of late California has contributed to the American supply, and latest of all the remarkable discoveries centering at Beaumont, Texas, have startled the world. Here gushers producing from 30,000 to 70,000 barrels of petroleum a day have been opened, and apparently the field waits for nothing but ample transportation facilities to become the most important of all factors in oil trade.

The greatest developed oil field in the world, in some respects surpassing even the American oil-bearing districts, is that which centers at Baku, a Russian port on the west shore of the Caspian Sea, just south of the Caucasus Mountains. The Caucasus is a great range which extends from the Black Sea to the Caspian Sea, forming the boundary between Europe and Asia. The country to the south of the range was formerly included in the ancient Asiatic kingdom of Georgia, but for the last century it has been a part of the Russian Empire, and is called the province of the Caucasus. The capital is Tiflis, about half way between the Black Sea and the Caspian. A railway connects Batum on the Black Sea, with Baku on the Caspian, passing through Tiflis.

The latter city may be reached, however, by a more picturesque route from Europe. The Russian railway systems in Europe extend to the city of Vladikavkaz, in the foot hills of the great mountain range, exactly opposite Tiflis. Between the two cities a remarkable road was built by the Russians nearly a century ago, called by them the Georgian Military Road. It is 126 miles from Vladikavkaz to Tiflis and a large portion of the way is traversed by this stupendous mountain range. The road passes through the Dariel Gorge, which for centuries has been the pathway of armies moving back and forth between Europe and Asia. This was the path by which the barbarians of the north made their incursions upon the highly civilized eastern provinces of Greece and Rome, and back through the same gorge the legions drove them. Now the peaceful traveler over this remarkable road crosses the summit of the range at a height of nearly 9,000 feet, among the eternal snows, and sees the peak of Kazbek frowning over him, that mysterious mountain upon which mythology located the scene of the tortures of Prometheus who was punished for his theft of fire from Mount Olympus. Once over the summit of the pass, the traveler descends into Asia by way of the most remarkable zigzag known to mountain roads. The accompanying illustration shows the descent down the mountain side from the barren granite above to the smiling valley below. In the course of the road as it may be traced in the picture, the distance traversed measures approximately ten miles and the descent is more than 2,000 feet.

The contrast between the titanic mountain scenery of the Caucasus and the industrial activities of Baku is a striking one. At Baku the earth and the air are saturated with petroleum. Hundreds of great oil wells are pouring their liquid wealth into immense reservoirs, to await shipment by rail or vessel to the European and Asiatic markets where the product is consumed. Sometimes a great well bursts from all restraint, and pours forth a flood of petroleum which runs to waste until the stream can be diverted into some earthen reservoir. When fires occur here there is little to do but let them exhaust themselves. Sometimes the losses reach millions of dollars before a limit can be placed upon the ravages of the flames. The Baku oil fields seem to be inexhaustible and already they have brought immense wealth to all those heavily interested in them. The annual product of petroleum here is nearly 50,000,000 barrels.

AFGHANISTAN, THE "BUFFER NATION"

The land of the Ameer lies north of India like a great wedge, having the sharp end at China and the head against Persia. The Ameer has been noteworthy because of his country's peculiar geographical position. This has made him the most prominent man in the councils of the Mohammedans because he was in a position to mediate and decide between the Moslems of India and those of Turkey. It also gave him great prominence in the political games of Central Asia, because he held neutral territory between the advance of the Russians from the north and the English from the south.

The Ameer is absolute in his dominions, and his rule is both personal and arbitrary over his four or five million subjects. Some of his punishments are very peculiar. As examples, an old man expressed doubts as to the wisdom of certain acts of the Ameer and he was sentenced to have the beard on one side of his face publicly pulled out. A baker who had been convicted of selling short weight was sentenced to sell over weight at the same price for a month. A young man became frightened at the appearance of horsemen in the distance and so

LHASSA, THE FORBIDDEN CITY OF THIBET.
This picture of the mysterious Buddhist capital is from a painting by a Thibetan artist.

reported that the Russians were coming. For this he was compelled to stand from daylight till dark on the top of a post, just within reach of a soldier's bayonet and yell at the top of his voice, "The Russians are coming to Kabul."

The Afghans are divided into clans or tribes. They are good horsemen and are almost wholly agricultural in their pursuits. The English have tried to bring them under their influence both by war and by bribery, but the use of force has been disastrous and the bribery but of temporary value.

BOKHARA AND CENTRAL ASIA

Down in the heart of Central Asia is the Russian vassal state of Bokhara, recently opened to the world, or at least to those who obtain permission from the Russian government to visit it, by the construction of the Transcaspian Railway. Until the conquest of the Khanates of Turkestan by the Russian Empire within the last thirty years, the capital of this remote native state ranked with Mecca and Lhassa as one of the forbidden cities of the world. Hardly more than fifty years ago, two English officers, making their way to the city of Bokhara from India to negotiate a treaty of peace between Great Britain and the Emir, were put to death by the most horrible tortures, prolonged through a considerable period.

Since then the Russians have built a great railway, parallel with the one more celebrated a thousand miles farther north, which penetrates the deserts and plains of Central Asia almost to the frontiers of India and Mongolia. The Transcaspian line has been kept in the background by the Russians, while the Transsiberian line has been made conspicuous in every way. The reason for this is that the former was built entirely for military and political purposes to threaten the Afghan and the Indian frontiers, and to facilitate the conquest and maintain the peace of the Czar's new possessions in Central Asia. So it is that the famous old cities of the realm of Genghis Khan and his great successor, Tamerlane, are now reached by the direct line of railway from the Câspian Sea.

Tashkend, Khokand, Samarkand, Bokhara and Merv are stations on the line where Orient and Occident meet in peculiar conglomeration. The ancient architectural remains left by Tamerlane are still beautiful and sufficiently preserved to reward the long and tiresome journey required to reach them. The tomb of Tamerlane stands in Samarkand almost as it stood five centuries ago, a noble dome rivaling in its own way the tomb of Napoleon in Paris, or the Taj Mahal of India. But the Russians are today dominant in all the great land included in Tamerlane's realm. It is merely a Russian figure of speech to call Bokhara, Khiva and the other vassal states which they tolerate even semi-independent. The Emirs are left a shadow of authority over their own people, but the paw of the Russian bear reaching down from the north is over them all.

TIBET, THE HERMIT NATION

Buried deep in the heart of Asia, and separated from the burning plains of India and from the populous regions of China by stupendous ranges of snowy mountains, there lies a wonderful land. This land is Tibet. Its physical features are most remarkable, for the country seems to consist of a vast central plateau, the greater portion of which lies at a higher elevation than the top of Mont Blanc, and from which descend on all sides great valleys, traversed by the Hoang-ho, the Yang-tsze-kiang, the Brahmaputra, and the Indus. The Tibetans themselves are a morose and gloomy race, and sunk in poverty and filth, seem to be degraded members of the human family.

But perhaps it is the religion of the Tibetans which is the strangest feature of the country, for the Tibetans are Buddhists of a most extraordinary character. All over the mountains in the inhabited portions of Tibet, are scattered the convents of the Lamas, which are full of monks and nuns, ruled by abbesses, and by Lamas in red and yellow robes, with mitres on their heads, and with tridents and praying-wheels in their hands. Multitudes of pilgrims traverse the roads which lead to the holy city of Lhassa, the capital of the country; and in the great temple at Lhassa, which is splendidly adorned, the Buddhist priests and monks chant the service, in the presence of crowds of devout worshippers.

Another wonderful thing connected with Tibet is the jealous way in which it is guarded by its inhabitants, and the extraordinary care taken by them to prevent Europeans from entering the country. On the side of India every mountain pass is carefully watched, and any European who attempts to enter Tibet from this direction is instantly turned back. On the side of China the frontier is guarded with equal care, and so perfect is the cordon in this quarter, that although the borders of Tibet may be reached, they cannot be passed.

The Indian Government has trained Hindu Pundits to travel in Tibet and make scientific observations; but even this has to be done with great secrecy, and their scientific instruments have to be carefully concealed. On the frontier, these Hindus are strictly examined by the Tibetans, and are frequently turned back. Often, however, they are successful; and after traversing unknown portions of Tibet, they return to India and report their discoveries to the officials of the British Government, by whom they are rewarded.

The most remarkable journey undertaken by these trained Hindus was performed by the Pundit Nain Singh in 1874. He entered Great Tibet from the west, and leaving the head waters of the Indus, ascended to a vast table-land, divided by a range of mountains from the Brahmaputra on the south, and stretching away for an unknown distance towards the north. Having reached Lake Namcho, he crossed the snowy mountains which rise along its southern border. Then he entered the habitable portion of Tibet, with its towns, convents and monasteries, and ultimately made his way into Assam, and thence to Calcutta.

Others have lost their lives in attempting to penetrate to Lhassa, the capital. A. Savage Landor was desperately tortured and mutilated before he was ejected from the territory. Only foreign occupation with troops can open this strange land to visitors and to modern civilization.

THE YOGI OF INDIA

The possession of mysterious and occult power not possible to ordinary mortals has been for ages attributed to a sect of hermits in the mountains north of Delhi in India.

They live in monasteries like those of the Middle Ages and have the cadaverous look to be achieved only by extraordinary self-training in feats of bodily suffering and endurance, as practiced by the severest ascetics. They claim to be able to do naturally by their occult powers, what to ordinary mortals is miraculous and supernatural. They throw a rope into the air, in the semi-darkness of evening, where it remains suspended till one of them climbs up on it out of sight and returns. They bury one another alive and at the end of weeks or of months disinter and revive the one who was buried. But regardless of the vast mass of evidence regarding these miracles, they are but little believed in and have been often explained as optical illusions and clever tricks. They claim to attain to the power even of the suspension of animation through severe fasting and mental abstraction. Throwing themselves into a state of hypnosis, they are able to suffer many remarkable things to be done with themselves.

They are the religious conjurers of India and have long been able to impress their mysteries upon many learned men of undoubted sincerity and honor. However, their feats have lost their serious interest to all but the Theosophists, and no longer deserve more attention than given to combinations of conjuring with hypnotism.

THE ISLAND TEMPLES OF INDIA

Elephanta, which the natives call Gallipouri, is a small island on the Indian coast, nearly opposite Bombay. The huge stone elephant on the south shore, which has been apparently split in two by gunpowder, gave its name to the island, and is so good an imitation of the real article that, at a short

A SNAKE-CHARMER.

distance, even an eye accustomed to elephants might be deceived. This seems to have been a work of supererogation, a sort of playful freak on the part of the architect, mortal or otherwise, that served as a preparation for the wonders to be seen within the cavern pagoda. The horse, too, is reprehelmet of the warrior, others with crowns ingeniously wrought, and splendid with jewels, while some of the heads are without ornament, save that of curled or flowing tresses. Hands are plentiful with these heroes and princes, who do not appear to have found four, or even six, too many for them; and these numerous hands are generally filled with sceptres and shields.

Some of these worthies have undeniably bad countenances, and are described by an ancient writer to be of such "horrible and fearful forms," that they "make a man's hayre stand upright." Others look serene and benignant, while on the features of others are marks of dejection and anguish. The gorgeous Indian dress in which they are attired, with heavy ear-jewels, magnificent collars sparkling with gems, fancifully wrought belts, and rich bracelets on arms and wrists, makes a picture that fairly dazzles amid the gloom of the cavern.

The nearest of these figures to the entrance, and facing it, is an enormous bust. Its three heads, joined behind the ears, represent the grand triple deity of India—Brahma, Vishnu and Siva. The great breadth and depth of the central head are evidently the sculptor's expression of the supreme presiding deity. A face that is five feet long, with a nose of a foot and a half, conveys a practical idea of power that is further enhanced by a shoulder expansion of twenty feet. An immense jewel sparkles like a solitary star in the pyramidal cap that crowns the head, while a broad collar of pearls and other precious stones adorns the neck. The sleepy, placid expression of the face is supposed to express "that absorbed state which constitutes the supreme felicity of the Indian deity."

The head on the right of Brahma is the preserver, Vishnu, smiling and gazing with rapt admiration on the sacred lotus which he holds in his left hand. The destroyer, Mahades, scowls on the other side, and looks the very incarnation of malice. His tongue is thrust out, and the large hooded snake grasped in his right hand seems only the natural expression of his own evil nature.

On either side of this triple-headed bust is a majestic, whole length figure, wearing the three-fold cord of Brahma, and supposed to represent a subdar, or priest of that deity. Farther on is the figure of an Amazon, which seems curiously out of place

HINDU BABY IN ITS CRADLE.

in a Hindoo temple. It is in the midst of thirty uncouth statues, and has four arms, the right fore-arm resting upon the head of a bull. The left fore-arm hangs down, but whatever it holds has been mutilated past recognition. The hand of the hinder right arm grasps a hooded snake; the left a round shield. This brings back the theory of Semiramis; but it is supposed again that, as Herodotus writes of Scythian Amazons, the statue may be accounted for by the connection which, in early ages, seems to have existed between India and Scythia.

A SIAMESE BELLE

The sacred Zennar of Brahma which adorns so many of these sculptured figures, the striking representations of the very gods now worshipped in India, and the assertion of Niebuhr, who declares that he saw the islanders paying homage to the images in the temple of Elephanta, all seem to contradict the theory that the rites of a religion quite different from that now prevailing in India were practiced in these cavern pagodas.

At one end of this wonderful temple is a dark recess twenty feet square, with no outside ornament except the eight naked figures, thirteen and a half feet high, that seem to be starting from the wall to which they are attached. These figures are ornamented in the same gorgeous fashion as the other statues, with rich collars about their necks and immense jewels in their ears. They guard the sacred mysteries of a debasing worship, whose serpent-like trail disfigures all Indian temples and paintings.

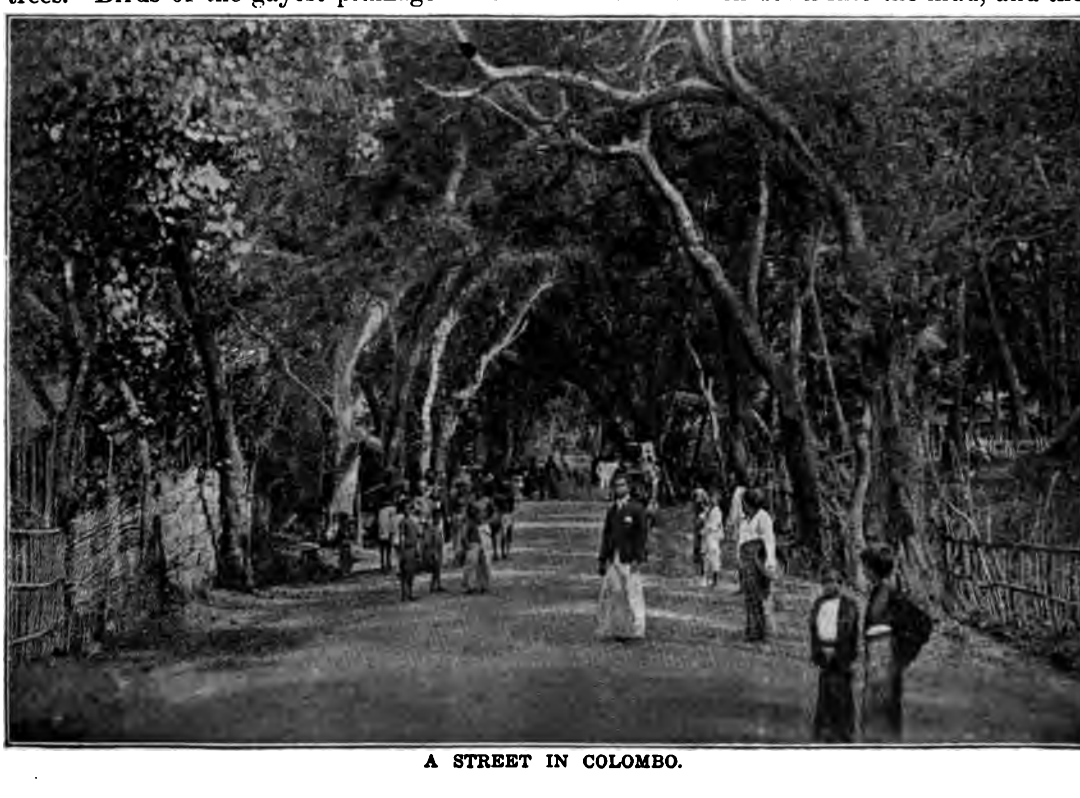
The crushed appearance of Elephanta's flat roof and comparatively low ceiling is a prominent defect in this famous temple; but it is, nevertheless, a palace of wonders, and in contemplating the life-like forms that stud the massive rock from whence they seem to have sprung, the spectator almost feels that the spirits who were supposed to work in the bowels of the earth could alone have accomplished such results.

SIAM AND ITS STRANGE PEOPLE

Siam is the Holland and Venice of the far East. During a part of the year the best of its lands lie under water and the people move from one village to another in boats. The rivers and canals are the highways of the kingdom, and the city of Bangkok, the royal capital, has more houses built upon piles than have the piled cities of Amsterdam and Rotterdam, and its canal streets surpass in number the waterways through which go the gondolas of Venice. Bangkok is even more built upon the waters than is the famed queen city of the Adriatic. Venice rises from the sea and its foundations reach down into its sand. Bangkok floats upon the bosom of the mighty Menam River, and its hundred thousand dwellings rise and fall with the tide. The Menam is called the mother of waters and Bangkok, its most beautiful daughter, is soothed during the day and lulled to sleep at night upon the bosom of this mighty mother.

Bangkok has few things in common with its sister city of Italy, and it differs from Venice as the half-nude savage maiden of the tropics, laden with barbaric gold, differs from the fashionable girl of our modern civilization, clad in her latest Parisian dress. Imagine a low, flat country filled with the most luxuriant of tropical vegetation. The wind sighs through the palm trees. Birds of the gayest plumage fill the air with their tropical songs. In the jungle is heard the chatter of the monkey, and along the flat streams basks the alligator. A low, clear blue sky, in which the sun of the tropics shines its hottest, hangs over it, and at night the moon and the stars shine with an untold brightness. Sailing up this river, from the Gulf of Siam, at about thirty miles from its mouth, you note in the distance the spires of temples and palaces. As you go on, from out the palm trees on each side shine little one-story houses, their roofs thatched with palm leaves, and their foundations apparently rising from the water itself.

There are no cellars in Bangkok and each home has a hole in the floor through which the sweepings are thrown. At two or more corners of each of these dwellings a pole has been driven down into the mud, and the



A STREET IN COLOMBO.

house is anchored to these. Its owner pays a ground rent to the person owning the land on the banks in front of which the house rests. But in case of dispute the moorings are cut, and the house, family and all, float away to another location. There are fifteen miles of these floating houses. They line both banks of the river and the canals back into the jungle. It is not uncommon for the owner of a floating dwelling to anchor his

TEA-PICKER, CEYLON.

house in the middle of one of the narrowest of these water avenues, and boats passing by must get through as they can. The native houses of the land are built high up on piles, so that one could almost walk under their floors. Some of them have picturesquely pointed ridge roofs, but like the floating houses, they are as a rule small, and their interior arrangements are the same.

It is estimated that 50,000 out of the 700,000 people of Bangkok live thus upon the water. There are thousands of children here who have never had a play-ground bigger than the fifteen-foot veranda in front of their homes, and whole families live through generations in one of these three-roomed floating houses without having spent a night upon the land.

All of the women have short hair, and some of them would be beautiful were it not for the universal custom of betel-nut chewing. The betel-nut is the product of a palm tree. It is about as large around as a walnut, and its meat is of a soft, spongy nature, the taste of which suggests the astringent properties of the unripe persimmon. The natives cut these nuts into quarters, and when they chew them they add a mixture of pink colored lime and tobacco, which, with the betel-nut, makes the compound which they munch from morning till night. After a short time it becomes a cud, and they lodge this between the lips and the teeth when not engaged in chewing. The chewing produces a blood-red saliva, which turns the teeth from white to polished jet, makes the lips crack, contracts the gums so that the teeth become long black fangs, to disfigure what would be otherwise fairly beautiful faces. Betel-nut chewing is followed by all Siamese, from the lowest to the highest, and a nobleman going through the streets has always his servant following him, bearing a box of silver or gold half the size of a cigar box, in which are choice mixtures of betel and lime.

All of the Siamese men, women and children, smoke as well as chew. You see cigarettes and cigars, unlit and half-smoked, behind the ears of both sexes.

Siam is the land of the white elephant,

and the king has four white elephants in the imperial stables which adjoin his palace. Great burly beasts with mouse-colored skins speckled by disease, they have been shorn of their glory, and their tusks are no longer bound with gold nor are their bodies swathed in cloths of purple velvet. Heavy ropes have taken the place of golden chains in binding their ankles. These elephants are often used in the grand processions of the king. At such times they are decorated with something of their old grandeur. Pavilions are tied upon their backs and the royal family ride out in state.

CHINESE FOOD AND COOKERY

John Chinaman always has a bowl at his elbow at meal-time, which he fills with rice from a vessel on the table, a large spoon or ladle being used for this purpose. This bowl is held in the left hand, and brought near the chin from time to time, when the rice is shovelled into the mouth by a pair of chop-sticks, taken between the thumb and fore and middle fingers, instead of being used separately, one in each hand, as is sometimes supposed. In the boats on the rivers of China, children of all ages are seen, late in the day, with bowls, which they take to their mothers to be filled with rice, and it is curious to see the avidity with which they consume their invariable diet. Many poor people know no other dish than this; but those who can afford a little variety, are glad to spend a few "cash," as the smaller Chinese coins are called, in the purchase of fish, flesh or fowl, to give a relish to their monotonous vegetable. On the river boats may be seen the rude implements of these floating kitchens, consisting chiefly of a large boiler, resting upon an earthenware pan. This serves as a furnace, and "all-outdoors" does duty as a chimney. Within the pot containing the rice, as it sizzles and steams away, are pans placed on a grating. They hold such savory accomplishments as the natives use for side-dishes.

The Chinese are very fond of gelatinous substances, and this accounts for their using animals and parts of animals for food which are rejected in other countries, and their penchant for such delicacies as tripang, birds'-nests, sharks'-fins, fish-maws, and agar-agar, a vegetable glue made from sea-weed. Among fish, the sturgeon is highly prized, and, as in classic times, is considered worthy of a princely banquet. The expression "caviare to the general," used by Shakespeare to illustrate anything above the taste or comprehension of the common people, attests the estimate formerly placed upon this fish by epicures, caviare being the roe of the sturgeon. A very choice delicacy for Chinese tables is sturgeon skull-cap, made from the most select portions of the royal fish. Shark-fins and pork are also highly esteemed. An English traveler, who partook of a dinner at which these were served, says the Chinaman must have smiled at the unreasonable prejudices of the Occidentals when he saw some of them tasting the pork, but fighting shy of the shark. He adds that the monster's fins were boiled to so soft a consistency that they might have been turbot-fins. The Chinese pork has a shining, flabby appearance which is not attractive to foreign eyes, and its rank, coarse taste does not invite renewed attention from the wary stranger. Cut into thin slices and fried in soy, which relieves the gross flavor of the meat, it is not absolutely repulsive.

SAILING SLEDGES ON THE GRAND CANAL OF CHINA.
In winter as in summer the Chinese waterways are the chief arteries of traffic. To assist his progress the ingenious Chinaman rigs up a sail in the manner pictured.

One of the most cherished delicacies of Chinese epicures is the beche-de-mer, or tripang, a kind of sea-slug, fished for on the coral-reefs of the Eastern seas. This marine animal is hardly less peculiar in his habits and appearance than the "heathen Chinee" who delights to devour him, being both tough and flexible, able to stand erect and graze on the sea-grasses, or to crawl and digest vast quantities of shells. With his tubular feet, or feelers, he seizes the unwary mollusk, which, firmly held by these suckers, is passed into the mouth of the slug, where it is speedily crushed and thrust into the stomach. From his resemblance to the familiar product of our gardens, this wandering echinodern is called by sailors the sea-cucumber.

Another gelatinous delicacy of the Chinese is the birds'-nest. This is the habitation of a small swallow called, from its having an edible house, Hirundo esculenta. These nests are found on most of the rocky islets of the Indian Archipelago, though Java and Sumatra furnish the principal supply. They are composed of a mucilaginous substance resembling coarse fibrous isinglass in external appearance, and in color are reddish white. Hardly thicker than an ordinary teaspoon, the weight of one of these little articles is from a quarter to half an ounce. The quality of the nests depends on the character of the caves, and the time in which they are taken. The best are obtained before the young swallows are fledged; next in value are those containing eggs only. Those which have been occupied by the newly-fledged birds, are rendered nearly worthless by blood, feathers and dirt.

These nests are obtained twice a year, the most valuable being found in deep, damp caves, which, unless essentially changed in character, will long continue to shelter the swallows and their nests. It was formerly supposed that the materials used by the birds in building these habitations, was the spawn of fish, or of beche-de-mer, but this view, however conformable to the principle of natural selection on the part of the birds in choosing such dainty delicacies to gratify the Celestial appetite, seems to be contradicted by the fact that some of the most productive caves are situated fifty miles from the sea.

The difficulty and danger experienced by the gatherers of these nests, furnish a new illustration of the tyranny of the human palate over the lives and happiness of men. To obtain the nests is the business of persons who have been trained to it from their youth, for no inexperienced person could safely undertake it. The caves are approached by ladders of bamboo and rattan let down over precipices, often descending perpendicularly for hundreds of feet over a sea beating violently against the rocks. After reaching the mouth of the cave, the seeker for nests gropes along on narrow ledges, where he is obliged to cling with his hands to slippery crevices, and penetrate gloomy recesses, where a single misstep would precipitate him into the yawning abyss below, to be dashed to pieces by the turbulent surf. It is often necessary to use torches to light the wanderer on his way, and reveal the places where the nests are hidden.

The Chinaman, believing that cookery is the test of civilization, regards the carving processes of European and American society as conclusive proof of barbarism. An Englishman's mode of feeding, he says, allies him to the savages of Formosa; the chief labors of the slaughter-house being transferred to the dinner-table, and the principal work of the kitchen being performed by the stomach. "In remote ages, before we became civilized," said a polite Chinaman, "we used knives and forks as you do and had no chopsticks. We still carry a knife in our chop-stick-case but it is a remnant of barbarism—we never use it. We sit down to table to eat, not to cut up carcasses." Undoubtedly, the Chinese system is admirably adapted for dyspeptics, as well as for that large class of persons whom necessity or inclination prevents from taking exercise enough to digest a mass of solid food.

Cats and dogs are eaten to some extent by the Chinese, but generally when young and tender. As those intended for the table are usually fed upon rice, their flesh is more palatable and cleanly than that of their brethren in other countries. They are sold alive in cages, and their dolorous cries, sometimes attributed to consciousness of their impending fate, are more likely the result of ill-treatment on the part of the hawkers, or of discontent with their peripatetic prisons. To ascertain the age and health of these creatures, buyers open their mouths and examine the teeth, so that puss and pup are subjected to a good deal of disagreeable scrutiny before being swallowed by the Celestials.

BUDDHIST ROCK TEMPLE IN CHINA.

Frogs are favorite articles of food in China. They are caught by fastening a youthful specimen by the waist to a fishline, and bobbing him up and down in the grass and grain of a rice-field, the favorite resort of his older brethren. One of these old croakers jumps at the squirming youngster, swallows him whole, and is himself secured, while the young one is rescued from the maw only to be used for bait again until death relieves him.

It is not likely that Chinese delicacies of the table will ever become popular in this country. On the contrary, John Chinaman, appreciating the dietetic conditions of our civilization, will probably conform to our customs in this as in other respects. We shall long continue to use his tea, but it is more than doubtful whether the coming man will drink samshu, or eat sea-slugs, birds'-nests, cats or dogs.

CHINESE BEGGARS

The condition of the Chinese poor is very bad, judging from a European point of view, for in their wretched huts—they cannot be called cottages—there is an utter want of what we consider "home comforts"; the very expression is a mockery in connection with them and their mode of living. What wonder, then, that beggars swarm in every direction, for the line of demarcation between the very poor and the beggar classes is very slight?

The beggars of most Chinese cities may be divided into three principal classes, each miserable, dirty, and designing, but with differences, which must excite and demand pity in varying degrees. One class, the most numerous, perhaps most powerful, best organized, and most prolific in resources, is under a "head man," a species of gypsy king. This man is raised to his high dignity on account of his superior talents as a knave and extorter of money. "Whatever the beggars procure by begging," says the writer of a Chinese romance, "is given to the head man; and in time of rain or snow, when they cannot follow their calling, their chief provides them with food and supplies them with clothing."

The head man's duties are to estimate the wealth and resources of the chief shops in the cities, excepting, it is said, those of tailors and other artisans. He goes around to the owners of these shops, and bargains with them until they come to satisfactory terms. Two slips of paper, one green and the other red, are then pasted up in the shop, on which are set forth the head man's name, the amount of blackmail agreed upon, the days of payment, and a warning to the fraternity not to annoy the shopkeeper. The shop is thus protected, for the time being, against molestation by this man's tribe; but if the owner refuses to come to terms, the consequences are disastrous, for a crowd of ragged, filthy, brazen-faced, stentorian-voiced beggars is let loose upon him, and the transaction of business is rendered almost, if not quite, impossible, until at length, in his despair, he gladly agrees to pay a heavier contribution than at first demanded. The payment thus made by large shops is from $7.50 to $8.50 a year.

Only men are admitted into the beggars' clubs or guilds, and they all draw from the funds, accumulated as before described, certain stipulated sums, according to their abilities. The ceremonies attending births, marriages and deaths furnish the beggars with great opportunities. If a wedding be going on, they appear, shouting, "Good luck to you! may you grow in wealth and increase in honors! May your halls be filled with gold and precious stones! May you have numerous sons and daughters! Good luck to you, good luck to you!" On receiving a small gratuity they depart; but only to reappear the next day, and, after the expression of further congratulatory sentiments, to demand the fragments of the marriage feast. Much the same takes place after funeral feasts, and on such occasions it sometimes happens that a considerable sum has to be distributed among the beggars before they will allow the burial or ancestral sacrifice to proceed without interruption. To attain their end, they will even go to the length of getting into the grave and preventing the coffin from being lowered.

The following is a curious use to which beggars are sometimes turned. When a very irate creditor is weary of his debtor's delay, and cares more to annoy the man than to possess his money, he gives his bill to these beggars, compounding, perhaps, for part of the spoils; and sends them day by day to worry the miserable debtor into settling the account. Among their other means of gaining a living, beggars are employed to bury criminals after an execution; others, again, act the parts of shipwrecked sailors, etc., etc., and spread before them on the ground a harrowing description of their supposed sufferings. Some attach wisps of straw to their children, implying thereby that, in consequence of the extreme distress of the parents, they were for sale; though, if the truth were known, it would probably be found that these very children had been before hired to be pinched, and made to cry in order to excite pity.

Another class goes by the name of "high-flower people," but, notwithstanding their high-sounding title, they are decidedly a grade lower than the former class. They live in the outer courts of certain temples, and consist mainly of refugees from other districts. These poor wretches have their regular sources of income as well as the former class. In the middle of the seventh moon, when sacrifices are offered to the spirits from the tombs, who are then supposed to be maliciously using their brief month's holiday to sow sickness broadcast, these poor beggars come and claim the remains of the feast, which, after all, is but a scanty one.

The third class of beggars is that for which an asylum is provided. This is called by names signifying asylum for the fatherless and distressed, or asylum for relief. These beggars are not able-bodied, like most of the others, but are blind, lame, or maimed, or suffering from wounds, commonly self-inflicted. They often blind themselves to attract pity, when they are too lazy to earn an honest and independent livelihood. Besides actual self-mutilation, of which we could quote numerous instances, these beggars are not one whit behind their European confreres in simulating fractures, wounds, etc., and so crafty and skilful are they, that their devices need very careful inspection before the hideous imposture can be unmasked.

The number of beggars in some Chinese towns is almost incredible; in Ningpo, for instance, a city in which the population is estimated at 115,000, they are said to amount to between 10,000 and 11,000. There is no national system for relieving them, and they are left to do very nearly as they like, no Chinese statesman having as yet had the courage to deal with the difficult question efficiently. In former days, at Peking, the government used to keep up certain small tenements for their shelter, which were called "feather houses," from their being furnished with quantities of feathers to impart a little warmth to their wretched occupants in the piercing cold of a northern winter.

The Chinese beggar is incorrigible. He seems thoroughly to enjoy his wretched and squalid mode of living; and for the present at least, nothing that benevolent and philanthropic foreigners can do will avail much towards the diminution of mendicancy in the empire. That Chinese beggars are happy in their way there can be no doubt, as witness some of their sayings: "Three years a beggar, who would be a king?" and "The finest rice has not charms equal to roving liberty."

VLADIVOSTOK HARBOR, THE CHIEF RUSSIAN HARBOR ON THE PACIFIC.

RUSSIA'S PORT ON THE PACIFIC

Twice in the history of Russia has the Czar decreed a city into being. Two hundred years ago it was St. Petersburg, on the banks of the Neva. To-day it is Dalny, off the Yellow Sea, on Talienwan Bay.

In 1889 there was nothing at Dalny except a deep and spacious harbor. By 1902 there was a population of 50,000; broad, well-paved streets; handsome buildings, parks and gardens; theaters and concert halls; a railway station, and, perhaps, more significant of all, five stone piers, each from a quarter to a half mile in length, and provided with railway tracks, warehouses, and elevators. The Russian Government has shown that the Americans are not the only people who can run up boom towns.

The peculiarity of Dalny, however, is that for a boom town it is suspiciously substantial. It was built with an eye to the future. When three years old it looked more like an old resident than a squatter. It gave one the impression that the Russian "provisional" occupation of Manchuria was a mate to the English "provisional" occupation of Egypt. Both these occupations are not so much provisional as previsional.

Dalny means "Far Away." It is about 6,000 miles from St. Petersburg. It has a continuous connection by railway to that city. From St. Petersburg to Dalny by the Suez Canal it is forty-five days. Overland by rail it becomes about fifteen. Almost the same proportionate reduction can be made in the traffic from Berlin, Paris and London. With that traffic established, steamers will ply from Dalny to Shanghai and Nagasaki. With the route to the Far East via Irkutsk, Russia may begin to recoup herself for the four or five hundred million dollars spent since 1891 in the construction of her Transsiberian Railway system.

The natural advantages of Dalny are striking. The largest ocean-going vessels can steam into the harbor without the aid of a pilot and proceed directly to the new piers. There is no danger of ice blockades at any time. Navigation is clear all twelve months. Port Arthur is only forty-five miles away. Seoul, Wei-Hai-Wei, and other strategic points are not far distant. The commerce of the east cannot fail to transact a large part of its current through the new ports.

Dalny has no custom-house. According to the Russian authorities, it is to lie open to the merchant marine of the world. It is to illustrate the "open door" idea in its widest sense. The world received this announcement with some misgivings. Shakespeare has expressed his opinion of foolish curs that run winking in the mouths of Russian bears and get their heads crushed like rotten apples. It is never safe to presume too much on Russian inducements. But it is still a free port, and there is no reason why American traders should not enter by the Dalny open door as long as it remains open.

The ultimate fate of Dalny will be a matter of no very little interest. It is not every city founded by rescript or ukase that

WINTER SCENE IN A KIRGHIZ VILLAGE—SOUTHWESTERN SIBERIA.

lives. Such attempts to raise autocratic power above social and economic forces are often futile. The cities of Genghis Khan and other Oriental conquerors hardly survived their builders. Alexandria, on the other hand, has endured to the present day. There is no general rule. Some artificially created cities thrive. Others do not. What Dalny will do, or fail to do in the future will concern all nations that have interests in the Orient, and that means all the great nations of the world.

KOREA AND ITS AWAKENING

The little Empire of Korea always stands with the threat of international warfare hanging over it. The location of Korea has made it a bone of contention between its Asiatic neighbors for many centuries, and when the European powers fixed covetous eyes upon it, its position became even more precarious. Japanese and Chinese influence have struggled for favor in Korea for a long time, although the Chinese strength in the peninsula has been far greater in the past. In 1894, Japanese influence had become dominant at the Korean court and the result of the contentions and jealousies that arose was the war between China and Japan, fought over Korean controversies and upon Korean soil. Since then, the gradually reduced strength of China in all international affairs tended to leave Korea more at the disposal of Japan, until the European powers began to thrust their own interests forward and take a hand in the affair.

Then Russia and England became prime factors in the struggle. The Russians' occupation of Manchuria brought them into contact with Korea along the whole northern frontier of the little Empire, and gave them an immense advantage in whatever they should attempt. The succession of treaties dealing with affairs in the Orient, by which Japan and Great Britain became allies and France and Russia renewed and emphasized their own alliance, was stimulated no less by the Korean situation than by the Manchurian. Japan yearned to make Korea her own. Russia had Manchuria in her grasp, and it became a virtual moral certainty that the day of relinquishment of the Chinese province would be slow in coming if it ever came. So the threat grew that some day we might see the next great international war upon Korean soil for supremacy in the Orient.

Backward as the little peninsular empire is, its possibilities are considerable and its natural resources important. The people are frugal and industrious like all of the Mongol race, but they have little knowledge of the rest of the world and the progress of civilization. The population varies from 8,000,000 to 16,000,000 and the estimated area is 82,000 square miles. As far as its developments go, Korea is a purely agricultural country and the methods of cultivation are of a backward and primitive type, the means of the communication being few and difficult. Rice, wheat, beans, tobacco, barley, millet and oats, are grown. Gold, copper, iron and coal abound. Transport in the interior is by pack horses and oxen. There are a few telegraph lines in the country, mostly in Japanese hands, a postoffice has been established, and a railway to the capital, Seoul, is under construction by an American syndicate. The Koreans' own name for their country is "the land of the morning calm."

BAYONET EXERCISE WITH OSCILLATING DUMMIES IN THE RUSSIAN ARMY.
These oscillating dummies are placed on the top of entrenchments, which the soldiers scale. After they deliver their blows the soldiers, going through the ranks of their silent victims, place themselves in skirmishing order.

The introduction of western methods and ideas, and the struggle of western powers for control of the country, promise to make that phrase a misnomer before many years have passed.

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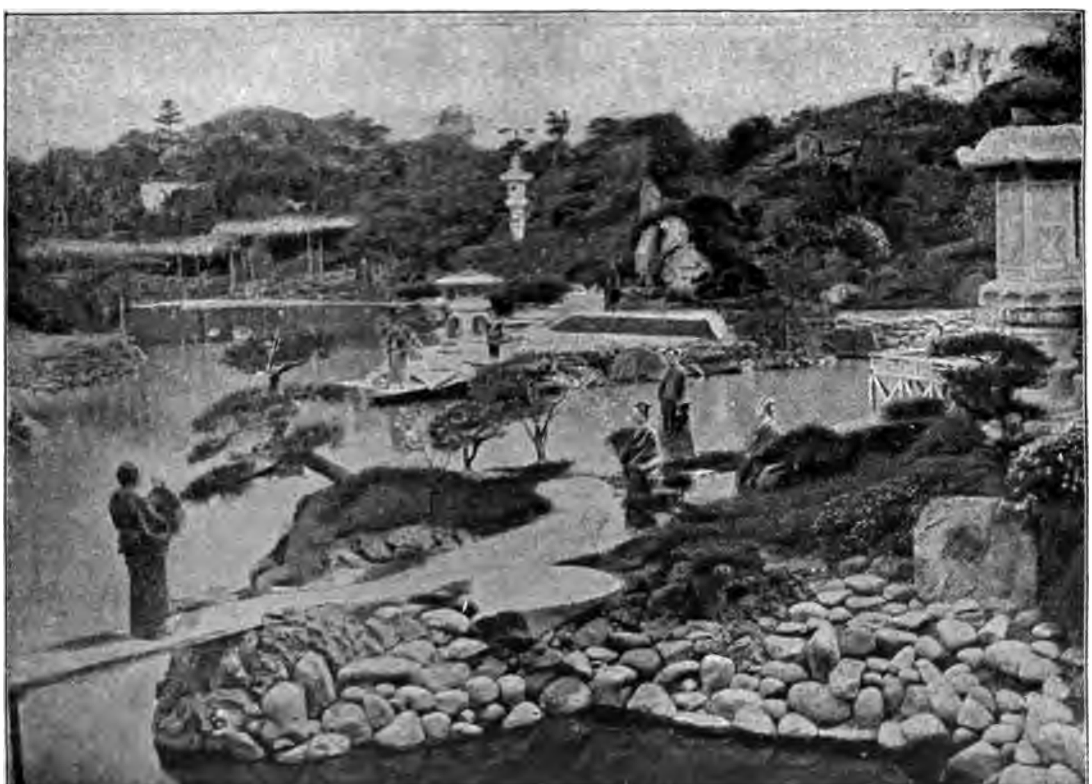
THE TEMPLES AT NIKKO, JAPAN

At Nikko are the most famous and the most elegant temples, in the highest state of preservation, placed in scenery at once grand and beautiful. These costly works of art are not so much temples to-day as national monuments. No words can convey an idea of their elegance or the richness of their decoration. No European cathedral or palace can compare with them in the latter respect. Of course they lack the majestic proportions of the famous Christian churches, but in variety, originality and richness of ornamentation they surpass the finest production of European builders. Many of them have substructures of stone, but the rich effects are produced by bronze and lacquer work, and by such carving as only Japanese artists have accomplished. The carvings are generally on the exteriors. Many are grotesque but all are full of life and action. In one place there is a frieze of large monkeys, one of which presses his paws upon his lips, another on his ears and a third on his eyes; also a sleeping cat over a gateway, so lifelike that one expects to see her move if disturbed. Outside and inside the most charming harmonies of color arrest the attention.



NIKKO, JAPAN, GARDEN SCENE.

very similar in its operations to the Carbonari of Italy.

Dr. Rizal was at last suspected of being at the head of the society. He was arrested and shot, while the band played rollicking airs and the Spanish ladies looked on and applauded. It was on Dec. 6, 1896, when he was led to execution from the side of a lovely girl who was made his bride while the soldiers were loading their muskets.

From Spanish persecution she was compelled to fly to the camps of the insurgents, where she was well nigh worshipped as the wife of their martyr-hero. In the bloody battle against the Spaniards at Silan she led the last charge, but they were driven back by the superior numbers and arms. Since 1900, she has been in charge of one of the public schools in Manila.

BORNEO AND ITS WHITE RAJAH

Borneo is a little larger than the state of Texas, and was the home of the worst savages of the Malay Archipelago. The interior of Borneo was long ruled by the Dyak head-hunters, who were docile, friendly and trustworthy beyond many of the other Malays, but whose religion taught them that every person they decapitated would be their slave in the next world.

At the opening of the nineteenth century, there was a fierce rivalry among the maritime nations for the control of the pirate-infested islands of the Malays, on account of the spice and coffee trade. The first compromise was that the Dutch were left unmolested in Java, the English held Malacca and the Malay peninsula, while Sumatra, Borneo and Papua were left to the savage natives.

In 1838 the son of an English clergyman, being of an adventurous spirit, sailed up one of the many small streams of Borneo with a little schooner having about a dozen sailors. He was burning with the ambition to emulate Pizarro and Cortez. He had the courage, for he had been wounded in one of the desperate battles of India, decorated for bravery and discharged on a pension before he was twenty-one. Fate caused him to land at Sarawak, which was governed by an old rajah who was apparently about to be overwhelmed by the Dyaks.

The young man's chance was here. He offered to conquer the Dyaks if the Rajah would make him general over all the military forces and direct heir to the throne. The Rajah had no intention of keeping his word, but all that was asked by the Englishman was solemnly promised. Young Brooke put each one of his sailors over an equal force of natives and soon succeeded in crushing the power of the Dyaks. The Rajah then ordered Brooke and his men to leave the territory, but Brooke appealed to the Sultan of the islands to confirm the justly-won promises. To the surprise of the English, in reply a courier came from Kuching, the capital, who proceeded to dismiss the old Rajah and to install Brooke in his place. The Englishman now had his wish and was king of Sarawak.

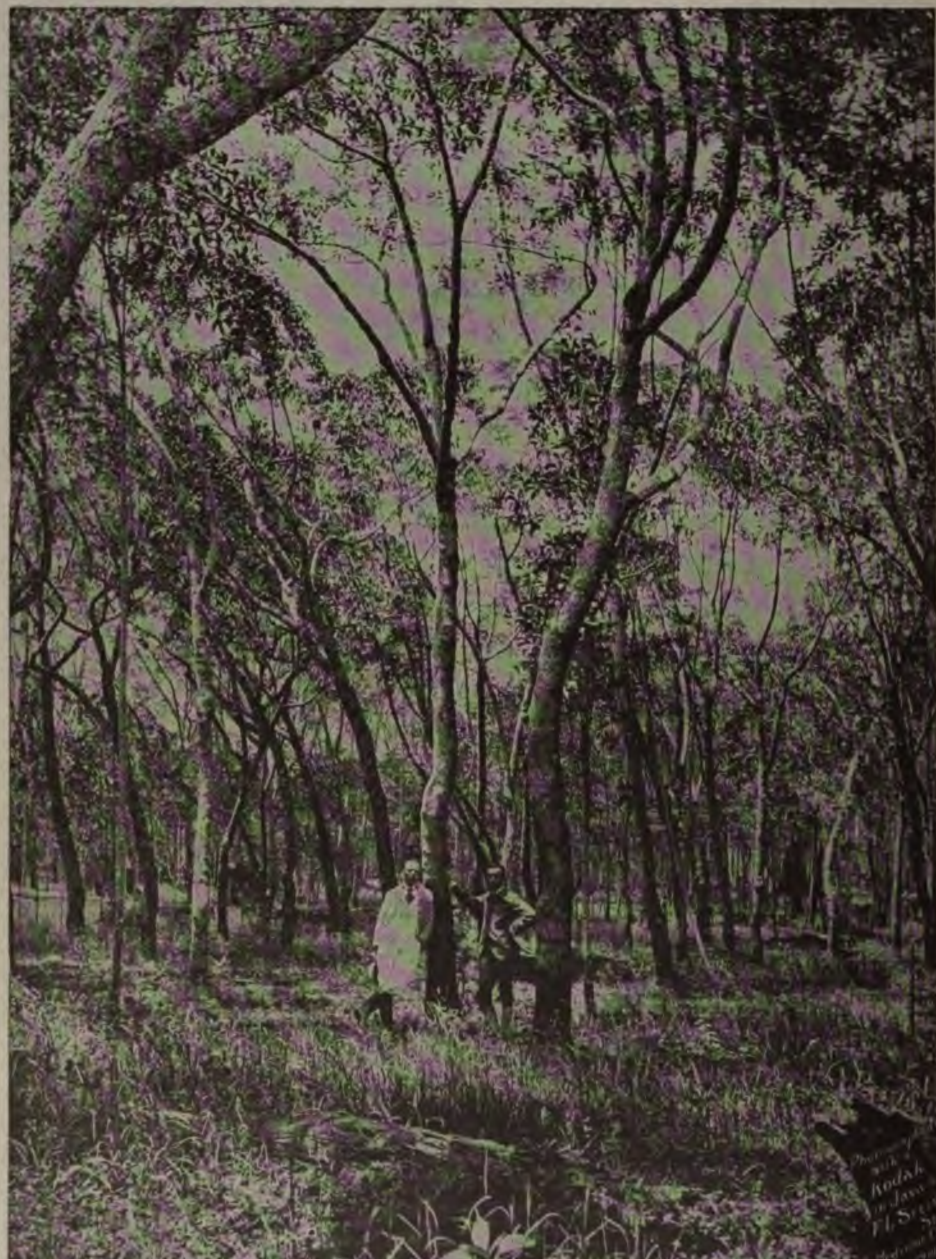
The head-hunters soon became his most devoted subjects. However, his people lived by piracy, were polygamists and slaveholders, therefore his task of Christian government was an appalling one. In five years he had civilized the people as far as justice was concerned, and had established a system of schools, churches and courts. At the end of ten years there was not a nook or corner in his dominions which was not yielding him faithful allegiance and obedience.

Then he visited England, where he was the lion of the day. He was banqueted by boards of trade and given the freedom of the cities. He was lodged in Balmoral Castle and knighted by the Queen. He died in 1868 and was buried with great honor in England. His nephew, who had been his faithful companion for many years, succeeded him and is now the white Rajah of Sarawak.

THREE CENTURIES OF WAR IN THE EAST INDIES

A war that has been going on for 300 years, is the conspicuous fact in the history of the Dutch colonies in the East Indies. Lying to the southeast of Asia, and extending almost to the Australian coast, is that great archipelago of tropical fertility which has contributed so generously to the wealth and prosperity of the little kingdom of the Netherlands. The total population of the Dutch East Indies, according to the last returns, is approximately 35,000,000, or seven times as great as that of the mother country, while the area is about 735,000 square miles, or more than sixty times that of Holland itself. It was in 1602 that the Dutch created their East India Company, which conquered the islands and ruled them during nearly two centuries until in 1798 the company dissolved and government was assumed by the Dutch kingdom. There are a dozen or more of the islands of which the area much exceeds that of Holland itself. Java, Sumatra, Borneo, Celebes, and New Guinea are the more famous of these great tropical islands, but of these Borneo and New Guinea are not entirely owned by the Dutch, as Germany and England have large possessions there also.

In spite of the schools, the churches, the increased commerce and prosperity of the islands, the careful administration of justice and the honest and intelligent colonial government to which Dutch publicists point with pride, they have not been able in three centuries yet to overcome the resistance of large elements of the native population to alien rule. For three centuries the Dutch have been in absolute control of the islands as far as their relations with other countries are concerned, directing all of their industrial and agricultural development and maintaining authority by a large colonial army, partly brought from Holland and partly recruited from the friendly native races. In spite of this long period of control, there are large areas in these great islands which are pacified only as far as the range of the Dutch rifles extends. They have garrisoned military posts at intervals, and the territory immediately surrounding these posts is peaceably accessible to the Dutch tax collector and safe for the visit of the traveler. But in the depths of the tropical forests, out of reach of protection from the soldiery, the white man is not safe. These races who have been fighting for their freedom from Dutch rule for 300 years of bitter and ofttimes cruel warfare, are akin to the Moros and the other more warlike tribes of the Philippine Islands. It is not a pleasant prospect for us to face in contemplating the course of our own history in the Orient, as it is to be developed within the next few years, but inasmuch as this experience of the Dutch harmonizes so exactly with that of the Spanish who had been themselves fighting in the Philippines for as long a period, the lesson should not



QUININE (CHINCHONA LEDGERIANA) TREES (PERUVIAN BARK).
It is these trees which produce the Peruvian Bark, or Quinine of Commerce.

be lost upon us. Holland has poured millions of dollars into the effort to subdue their rebellious subjects in the East Indies, and although the tropical products which have brought wealth from the colonies to the little kingdom have more than compensated this money cost, there are thousands of killed and wounded and diseased soldiers every decade to be reckoned as the largest item in the price of colonial power in the Orient.

THE UNITED STATES OF AUSTRALIA

With the first year of the twentieth century, a new commonwealth was born into the family of nations, so nearly a nation itself as to justify a warm welcome into the sisterhood. Away down in the South Pacific Ocean, the British Colonies which have been known as Australasia have federated, and have formed a great union not unlike the union of the American Colonies into the United States of America. The only one of these far-away colonies omitted in the consolidation, is New Zealand, which lying more than a thousand miles to the eastward of the Australian continent, and having many diverse interests, decided that in its case independence was better than union. In the Commonwealth of Australia, therefore, are united the five continental colonies of New South Wales, Victoria, Queensland, South Australia and Western Australia, and the little island to the southward of the continent, called Tasmania. In organizing their government, these federated colonies went through many of the same difficulties and faced similar problems to those that were solved by our own colonial fathers in the days when they were organizing the union of the states from the federated colonies. Meeting the same conditions as they did in many details, the Australian statesmen studied with care the form of the American government and used our political history to draw from it such lessons as were applicable to their own situation.

As with us, the individual colonies thus becoming the states of the Commonwealth of Australia retain their own control of their own internal affairs, simply yielding such functions to the national government as can best be administered by the general organization. As in our country, each state has its own governor, local legislature, executive department, and judiciary department. As with us, too, the national government of Australia has the same organization of two legislative bodies, an upper and a lower house, in its parliament, and its own executive department and courts for national affairs. One conspicuous difference, however, comes from the fact that in Australia, as in most other free countries except our own, parliamentary government exists above the executive, and a changed majority in parliament requires the change of executive and the formation of a new ministry or cabinet.

In our own country, as is, of course, clearly understood, the President and his cabinet of personal appointees may and do hold office through the term of his election, irrespective of the partisan character of congress, or the changing opinions of the country at large as expressed in intervening elections. This, therefore, results in the condition that the President may be an adherent of one political party, while congress has a working majority of the opposition. Under such circumstances, legislation becomes virtually blockaded, for the legislative and the executive must be in agreement under our system, before legislation can find its way to the statute books.

This kind of a deadlock cannot occur in a country which is governed by the parliamentary system, with what is known as a responsible ministry. The governor-general in such a country as Australia is not, in fact, the executive, but a virtual figurehead, with important social and personal functions, but little influence and no authority over the affairs of the country. When parliament is elected, with a certain political majority of one party or the other in control, the governor-general calls the recognized and admitted leader of the party in control and delegates to him the formation of a ministry. The leader thus designated becomes the premier, and may at his own choice assume whatever portfolio in the cabinet he desires. In effect, the premier then becomes the chief executive of the country, and remains so until a parliamentary majority should be cast against some measure which he proposes or in the form of a vote of "no confidence." When that occurs, he must resign with his cabinet, when the leader of the opposition which has now become the majority is in turn called to form a ministry. The alternative before a premier thus defeated in parliament, instead of resigning, is for him to "appeal to the country," as the saying is, by calling a new election. In the event that he is sustained by the popular verdict in his favor, as would be demonstrated if a majority of parliament again voted in his support, he would still hold his office.

The fact that the premier and all his fellow members of the ministry must be members of one or the other house of parliament, serving in their places as do the other members, makes it possible and necessary for them to enter into debate when measures are under discussion to support their parties' position. At the same time they are more readily subject to be questioned and criticised by their fellow members of parliament than they would be if they were at long range, sequestered in their department offices. It is evident that the Australian system, or, more broadly speaking, the system of responsible ministries and parliamentary governments, makes the legislation of the country and the acts of the executive much more promptly amenable to the public will than can be true under our own system, where both legislatures and executives are elected for a fixed term of office. Whether or not this is an advantage may be left to the individual judgment of the reader. Beyond question, there are points in favor of both systems.

The Australian Commonwealth is going through difficulties in the way of selecting a capital not unlike those which our own republic faced in its young days. Just as New York, Baltimore, Philadelphia, and our other important colonial cities strove for the honor, so have Adelaide, Melbourne, Sydney, and Brisbane sought for the distinction in Australia. And just as with us a compromise was effected, a new site chosen where no city was, and a new federal district created to be entirely under the control of congress and not subject to the authority of any state, so Australians have solved their problem. They have decided that the federal capital shall be within the State of New South Wales, which is known as the mother colony of Australasia, but not within 200 miles of Sydney, the metropolis of the continent. Until the final selection of this favored spot shall be made, Melbourne is to be the commonwealth capital temporarily. The presumption is that Albury will be the fortunate town selected for the permanent capital. Albury is a picturesque and thriving town on the banks of the Murray River, which here forms the boundary between New South Wales and Victoria, the two most populous colonies. The railway systems of the two colonies meet here, and a great railway bridge unites them. Here will be established a federal district under parliamentary control, not subject to the government of either state, and here, if Australian expectations are fulfilled, will grow up a city to rival our own Washington in its architectural beauty and political importance.

A new nation not only needs a constitution and a capital, but a flag as well, and the choosing of the emblem aroused the utmost interest throughout the commonwealth. A prize of $1,000 was offered for the best design, and more than 30,000 suggestions came in to the office where the competition was directed. The difficult task of making a final selection was entrusted to a committee of naval experts. The same design had been submitted by five competitors, so that each received $200 as his share of the award. The Union Jack occupies the upper corner of the flag, at the staff. A large six-pointed star under it denotes the six states of the federation, and the Southern Cross, that beautiful constellation known to every traveler in the southern hemisphere, is marked on the other end of the flag. This new flag is one with which we are likely to become familiar, for the trade between Australia and the United States is increasing with great rapidity. The Australians are among the most enterprising of people. They have a continent of enormous resources, hardly beginning to be developed, and their commerce is the largest, per capita, of all the countries in the world, so that we are quite justified in maintaining the most cordial relations with our neighbor commonwealth in the South Pacific.

NEW ZEALAND, THE LAND OF LIBERAL LAWS

We are accustomed to speak of China and Australia as the antipodes, and yet, as a matter of fact, those countries are not our antipodes at all. The exact opposite to the central portion of the United States of America is found away down in the Indian Ocean, about half way between Australia and Madagascar. Down in the South Pacific Ocean, however, is the island colony of Great Britain named New Zealand. The people of New Zealand like to call their country the Great Britain of the south, and there are many points in common between the two countries which suggest the parallel. New Zealand, like Great Britain, is an island country, composed of two large islands, virtually the exact geographical antipode of Great Britain itself, and with the population as entirely English, Irish, and Scotch, as are the British Isles. Even the manners of life, the industries and the products are very similar, and the climate itself of New Zealand is not unlike that of Great Britain, although slightly warmer both in winter and in summer.

One detail in which New Zealand is a genuine opposite of Great Britain is in its legislation on industrial and financial questions. New Zealand is as radical as Great Britain is conservative, and the island colony has been called by one student "the economic laboratory of the world." The youngest of Great Britain's self-governing colonies as it is, New Zealand has made practical trial of a great many experiments in social reforms which people elsewhere have been contented to talk about. In the more conspicuous of these successful experiments, is the prevention of strikes by the compulsory arbitration law. In the period of seven years since compulsory arbitration was put into practice, the country has prospered and profited by it to a remarkable degree. In every detail the prophecies of failure have been contradicted. In the beginning the opponents of the law declared that nobody would submit labor disputes to a court for settlement; but instead of that, everybody has been ready to appeal to the law at the first sign of difficulty. It was declared also that no one would submit to the judgments of the arbitration court except the ones who were favored by the decisions. Yet in practice it has proved that the rulings of the courts have been accepted by both parties alike. It was prophesied, last of all, that such an experiment would cause the withdrawal of capital, the destruction of the credit of the country, and the collapse of its infant industries. Instead, exports have increased 35 per cent per capita in the seven years, the number of persons employed in factories and workshops

CAUGHT BY A SHARK; THE FATE OF A DIVING BOY.

At Aden on the Arabian coast, as in other tropical ports, boys come out to the steamers in harbor to dive for pennies which passengers throw into the water. Sharks infest the water. The snapshot was taken just as a great shark seized a diving boy and the horrible scene is clearly depicted. The boy's companion is horror-stricken, but the others do not know yet what has happened.

has doubled, and the increase of wealth and prosperity has not been confined to a few capitalists, but the mass of the population has reaped the benefit. In the seven years the number of persons with money in the savings bank has increased from 150,000 to 240,000, and the savings have increased from $20,000,000 to $35,000,000.

Of course not all of these improved conditions can be credited solely to the arbitration law, for New Zealand is progressive in its legislation in other ways. Nevertheless this law has been a most effective influence in removing the causes of strife between employer and employees, and New Zealand has become virtually a country without strikes. New Zealand likewise has an old age pension law, government life insurance, compulsory sale of real estate when wanted for settlement and postal savings banks.

Four out of six state Parliaments of Australia have adopted similar laws after observing the good effects of the New Zealand act. It is declared by New Zealanders that in the seven years this great social and economic experiment has substituted peace and good feeling for industrial war and bitterness; has converted a large majority of its bitterest opponents into supporters; has steadily and with amazing rapidity increased the production of the colony and the wealth of all classes of its people; and finally has so impressed the people of the countries nearest to it and best able to judge of its effects, that they are one by one adopting its provisions for themselves. Inasmuch as the relations of capital and labor form one of the most conspicuous problems which we have to face in this country, it is important to observe the results of such experiments elsewhere as may throw light upon our own puzzles.

TUTUILA, OUR SAMOAN ISLAND

One of the smallest of American island possessions in the tropics, although not the least interesting, is Tutuila, in the Samoan group. There is one feature about the American ownership of this little island in the South Pacific which makes it noteworthy among all our outlying dependencies. This is that the people are without exception friendly to the United States, their friendship having been established during years of international jealousies and strife over the possession of the group, during which time this country always stood for the natives themselves, as against those who would absorb their country.

The Samoan Islands lie some 2,400 miles southwest of Honolulu and 1,600 miles northeast of Auckland, New Zealand. Apia, on Upolu, the largest island, has been the capital of the group and the chief commercial town, being the port of call for steamships and the place where all of the white traders made their headquarters. At the same time it was the center of the factional fights between the rivals for the Samoan throne, and consequently for the machinations of the powers seeking foothold there. Robert Louis Stevenson, who sought the restoration of his health in this balmy island, and remained there until his death, has written of these political struggles in a book called "Eight Years of Trouble in Samoa." Here in the harbor of Apia occurred that disastrous hurricane fifteen years ago, which resulted in the loss of three German and three American men-of-war, and the death of a large number of sailors of the two navies.

But now apparently the warlike troubles of the Samoans are over. They have lost their political identity as a nation, as the price of peace and protection from two great governments. The United States acquired the little island of Tutuila, and to Germany the rest of the group was ceded. It is on our American island that we already had important rights gained by the treaty with the Samoans themselves thirty years ago. Here is the harbor of Pango-Pango, the best harbor, so navigators declare, of any in the Pacific Islands. Here we established a coaling station and a naval supply station. Here, too, is the port of call for transpacific steamers plying between San Francisco and Australia. As the years pass, therefore, Apia will lose its importance to Americans and Pango-Pango will rise. The island of Tutuila has an area of about seventy square miles and a population of 4,000. Tropical vegetation of all kinds grows luxuriantly, and the only commerce of importance is the export of tropical fruits and their products, most important of which is copra, the dried meat of the cocoanut, from which cosmetics and toilet preparations are made.

HAWAII, "THE PARADISE OF THE PACIFIC"

Among its other great possessions the United States now claims ownership of the largest of all volcanoes in the world. Out in the Pacific Ocean, 2,000 miles southwest of San Francisco, lies the Hawaiian group of thirteen islands, the eight larger

GRASS THATCHED HOUSE IN TAHITI—SOUTH PACIFIC OCEAN.

of which are inhabited. Here in the tropics are the first of the American possessions in the Pacific to be reached by the traveler visiting Asia or Australia. They lie in placid waters, and the tropic breezes that blow around them are balmy, but their history has been disturbed by many a conflict until the time they came into American ownership. It was here that Captain Cook, the great English navigator, lost his life at the hands of the natives, shortly after he first reached the islands in 1778. The native royal house lost its control in 1893, when the last queen, Liliuokalani, was deposed and the republic succeeded the monarchy.

The American influence has been strong in the islands for many years and their trade has been almost entirely with this country. Successive efforts to arrange an annexation failed in turn, until in 1898, during the Spanish-American war, the islands were formally annexed to this country. A year later Hawaii was created a Territory of the United States and the Honorable Sanford B. Dole, who was the President of the Republic, was made the Governor of the Territory. Honolulu, with a population of some 40,000, is the largest city, the capital, and the chief commercial port. The products of the islands are those common to the tropics, but the chief industry is the raising of sugar. The sugar production for 1901 was valued at more than $27,000,000. The other articles of export are coffee, hides, fruits, wool and rice, but the total of these does not amount to $1,000,000. The population of the territory has been decreasing ever since the discovery of the islands, until about ten years ago, since which time it has increased rapidly by immigration. The total population now is nearly 160,000. Of these the native race and the Chinese, Japanese and Portuguese form by far the larger portion, and the natives are steadily diminishing in number.

Here in the Hawaiian Islands are the largest of all volcanoes in the world, both active and extinct. Mauna Loa, Mauna Kea, and Kilauea are the greatest of these, and the eruptions which occur at intervals are splendid spectacular sights which attract visitors in great number from the United States to witness the display. Mauna Loa is 13,670 feet above the sea level and has several craters in the great basin of the top, the terminal one being a little more than a mile and a half across, a veritable sea of molten rock, by far the largest in the world. Eruptions sometimes take the form of enormous fountains. One in February, 1859, was a sheaf of white-hot fluid lava two hundred feet or more in diameter and about 300 feet high, which illuminated the country around to a distance of 150 miles.

THE LEPER ISLAND OF MOLOKAI

A land where one does not have to pay taxes or rents, and where a beneficent government provides cottages and rations, herds and clothing, and where not only blankets but even medical attendance are without cost, is not this a veritable Utopia? Yet such a land is our nearest neighbor in the Pacific, and is only some 2,000 miles distant. As one's steamer leaving San Francisco approaches the Hawaiian Islands, before it can drop anchor in the beautiful harbor of Honolulu, it must needs pass Molokai.

And Molokai? Why, that is the fifth island in size of the entire group of the Hawaiian or Sandwich Islands, and is some forty miles in length with an area of about 200,000 acres. On its eastern side are elevations of fully 2,500 feet, while on its western slopes they diminish to a height of about 1,000 feet. Its valleys are beautiful and are filled with deer. A herd of spotted deer, presented by the Mikado of Japan some thirty years ago, were placed by the King of the Hawaiian Islands on Molokai, and now number some 3,000, roaming at will over a large part of the island. Here are many kinds of the most luxuriant fropical vegetation, the balmiest air, the most invigorating sea-breezes, even such spicy breezes as blow soft o'er Ceylon's isle.

But though every prospect pleases, few persons can be induced to make their home on Molokai. The entire population is only some three thousand, and at the last census 1,120 of these were lepers. Possibly nowhere in the world is the census more carefully taken and more accurately known than is the case here in the northern part of the island. Molokai, as is well known, is the name for the leper colony of Hawaii. The lepers do not occupy all the island, but only a grassy plain, a mile in length, on the north side of the island, and yet separated wholly from the rest of the island and its population by a precipice fully a thousand feet high, which can be scaled at only one point, and here it is securely guarded.

Despite their freedom from taxation and rents, their ample supplies of food and clothing, their abundant herds of cattle and horses, and their fertile fields which require so little labor, the lepers are virtually life-prisoners, shut in by the ocean on one side and by the impassable mountain on the other. Most of the lepers are natives, but foreigners are found among the colonies, and all who once come to this part of Molokai, save to bring supplies or to inspect, as the Board of Health twice each year, do so with the expectation of never returning. At a cost of some $10,000 per month, the Hawaiian government maintains this open-air leper hospital in order to perfectly quarantine and thus finally stamp out leprosy among the Sandwich Islanders. Sheltered from the strong sea wind, this plain of Kalaupapa would make an ideal place of residence, alike for its beautiful surroundings and the salubrity of its climate; and here everything is done, compatible with preventing the spread of the disease, to make its unhappy victims contented.

ROBINSON CRUSOE'S ISLAND, JUAN FERNANDEZ

Juan Fernandez, of Robinson Crusoe celebrity, is a small island in the South Pacific, some four or five hundred miles west of Valparaiso. Besides the name by which it is more usually known, it is also called Mas-a-Tierra (nearer-the-mainland), to distinguish it from another island nearly a hundred miles farther west, and hence bearing the name of Mas-a-Fuera (farther-off-shore). It has one anchorage, Cumberland Bay, and there, facing the sea, is the settlement, consisting of a few huts and a ruined fort. The island appears to be of volcanic origin; and the huge masses of rock, piled one upon the other, rising to a height of nearly 3,000 feet, present a very picturesque appearance from the sea. Gentler attractions are, however, not wanting; there are at least two valleys rich in vegetation, and smiling with the luxuriance of an almost tropical fertility.

The chief interest of Juan Fernandez lies not in its external features, but in its eventful history, and in the legends which have gathered round its name. That name is derived from a hardy Spanish sailor who discovered it about the year 1563, and promptly obtained a grant of his "find" from the Spanish government. Here, like his more famous successor, Selkirk, he lived for a time "monarch of all he surveyed."

When next the curtain lifts, the island appears as the shelter of the bold buccaneers. It lay conveniently near to the Spanish settlements, for on Spain the buccaneers made war with savage ferocity.

In October, 1704, the "Cinque Ports" galley, one of Dampier's squadron, called at Juan Fernandez. There was a quarrel between Captain Straddling and his sailing master, Alexander Selcraig, or Selkirk, a native of the little fishing town of Largo, in Fifeshire, who refused to serve longer with his captain, and asked to be put on shore. When, however, his wish had been complied with, and he was left alone on the beach with some scanty stores, his heart misgave him, and he sought earnestly permission to return once more on board. But the brutal commander only made this change of resolution a subject of mockery, and left him to the charms of solitude. These Selkirk "enjoyed" for nearly four years and a half, till he was taken off in February, 1709, by Captain Wood Rogers of the "Duke" privateer. Selkirk was appointed mate of the "Duke," and died (1723) lieutenant of the royal ship "Weymouth." A monument was erected to his memory in his native place in 1885. Two circumstances have conspired to confer on this young Scotchman a kind of immortality; Cowper made him the mouthpiece for a charming poem; and Defoe's immortal story of Robinson Crusoe was suggested by his adventures, although the island of Tobago, off the mouth of the Orinoco, more nearly fits the geography of the story.

The Spaniard Ulloa, who visited the island in 1743, urged the Spanish government to fortify the island and convert it into a penal settlement and his advice was followed. When the South American revolution broke out, many of the Chilean and Peruvian patriots were condemned to exile here. At the end of the revolutionary wars the Chileans took over the settlement, and in 1819 established another penal colony. Again, in 1828 and 1833, convict settlements were formed; but the cruelties practiced on the prisoners led to outbreaks, successful in two instances. At length in 1835 the great earthquake destroyed the fortifications, and the convict establishment was finally abandoned. But the traveler who climbs the brow of a hill fronting the harbor, barely half a mile from the landing place, will still find the melancholy traces of these habitations of cruelty. The face of the cliff is excavated to a distance of several hundred feet, and long winding passages lead to the dark and dripping cells.

Since 1835, the Chilean government has leased the island to private speculators; and in 1868 it was purchased by Robert Wehrdan, a German engineer, who has established a small but thriving colony. In addition to tillage and stock-raising, hunting and fur-sealing, some trade is carried on with passing ships, especially whalers, which often put in for water. In the same year the British ship "Topaze" visited Juan Fernandez, and erected a tablet to the memory of Alexander Selkirk at a spot known as "Selkirk's Lookout."

IN THE FALKLAND ISLANDS

One of the most remote and least known of the island colonies of Great Britain is the little archipelago called the Falkland islands. These islands are situated far in the South Atlantic ocean, about 300 miles east of the Straits of Magellan and about the same distance from the southernmost tip of South America. The islands were discovered in 1592, and belonged successively to France and Spain before becoming finally a British possession in 1833. The area of the group is 6,500 square miles, of which East Falkland contains 3,000 and West Falkland 2,300 square miles. The remaining 1,200 square miles are divided among about 100 small islands. The island of South Georgia, lying some 900 miles east of the Falklands, with an area of 1,000 square miles, but virtually uninhabited, is attached to the same colony for government purposes.

The Falkland islands are treeless, but are well covered with grass. The climate is healthful, though bleak, and the cold winds and fogs from the Antarctic ocean frequently enshroud the islands. The temperature in the summer ranges from forty degrees to sixty degrees, and in the winter falls much lower. The highest elevation is Mount Adam, 2,315 feet. Sheep farming is the leading industry, the flocks numbering about 750,000. Wool, hides and tallow are exported, and provisions, wearing apparel, timber and machinery are imported. The population numbers about 2,100 and the chief town, Stanley, has something more than 700 inhabitants. The government is administered as that of a crown colony by a governor sent from England, who is paid a salary of $6,000 a year. He is assisted by an executive council and a legislative council. The little colony is fairly prosperous, with exports amounting annually to more than $600,000, and imports about half as much. There are government and religious schools, with a total of some 250 scholars. There is a volunteer military company of forty-four members, and a postal savings bank with more than 300 depositors. The colony is attached to the International Postal Union, and about 15,000 letters and post cards pass through the mails annually. Three or four vessels call every month, mostly for the exports of wool and hides to be shipped, although some of them are whaling vessels, cruising in the Antarctic ocean. The government of the colony lives within the income from import duties and rents of crown lands, and altogether the people of the islands do not feel either isolated or in ill luck in their far away island home.

EASTER ISLAND AND ITS STRANGE RUINS

Easter island is considered to be the lonesomest island in the world, by those who have cruised every ocean. Its name was given to it by the explorer who discovered it on a certain Easter Sunday, some centuries ago, but it is also the most eastern island of all in the South Pacific ocean. It is distant from the South American republic of Chile, to which it belongs, about 2,000 miles, and from its nearest island neighbor in any direction, more than 1,000 miles. Isolated thus as it is, it is seldom visited either for business or pleasure, although the few scientists who have journeyed to the island on voyages of discovery report it to be one of the most strikingly interesting places in the world.

Easter island is hardly more than the crater of an extinct volcano, yet its valleys are very productive and the people are easy-going and indolent. Lying so far out in the South Pacific ocean, and just outside the tropics, the climate is mild and equable. On this remote island are some of the most remarkable stone ruins known in the world. They appear in the shape of large stone houses with walls five or six feet thick, making a remarkable contrast with the light huts of reeds built by the natives to-day. These houses have been lined with large, flat stone slabs, on which are painted and sculptured figures of fabulous birds and animals, and huge geometrical figures. Near these houses the rocks are carved with odd human faces, sea turtles, and all sorts of devices and inscriptions. These ruins are quite as interesting as those of Egypt or Central America, and the people who dwell upon Easter island now not only know nothing of them, but have no traditions to account for their presence.

In addition to these ruins, giant monuments have been found cut from solid rock, usually in the form of a human bust and head. These line every prominent headland where suitable rock for carving could be found. Toward the east are immense walls and terraces, the stones of which are large and ingeniously fitted together without cement. The terraces are usually lined with statues, one of which is thirty-seven feet high, and cut out of red stone found only at a point three miles distant. How was it transported and set up? Who were the sculptors? Is this lonely island a footstep of some ancient American family on its way across the Pacific toward Asia, or is it an antique camping ground of some colony from Thebes and Nineveh on their way to America, who drew their artistic inspiration from the sculptures of the Nile or Euphrates? How shall such questions be answered? If the truth about the past of this mysterious island is ever learned, some strange puzzles will be solved.

STRANGE STONE FIGURES ON EASTER ISLAND.

THE MUTINEERS OF THE "BOUNTY"

One of the most interesting colonial experiments the world has ever seen was that which followed the famous mutiny on board the ship "Bounty," more than 100 years ago. The mutineers, under the leadership of a man named Fletcher Christian, turned the captain and the officers of the ship adrift in midocean and landed on Pitcairn island, which is several hundred miles southeast of the Society group. They were not heard of for many years, until by chance a ship called at the island and found it peopled with industrious, thrifty and peaceful settlers, living in contentment, and holding themselves in this isolation as a British colony. The original mutineers had married with the native women whom they had taken to the island. It was too late to punish any one for the mutiny so long past, and the settlers were left to live in peace upon the island which they had made their home.

Some time later, Pitcairn island was so unfortunate as to experience a disastrous hurricane, which destroyed houses and crops and left the islanders in great distress. The island itself, indeed, is little more than an immense rock with not much ground available for cultivation. About the middle of the nineteenth century, Great Britain ceased to use the Australian colonies as a place for the exile of criminals from England, and so vacated Norfolk island, which lies northwest of New Zealand, and had been the settlement for hundreds of the worst criminals. Great Britain, therefore, sent a ship to Pitcairn island and took the colonists from there to Norfolk island, a fertile and beautiful place, where they were given the use of all the buildings, prison and otherwise, that had been so fortunately vacated.

The Pitcairn islanders, however, did not rest contented there. They were homesick for their lonesome rock more than 2,000 miles to the eastward, and finally the greater number of them returned to it, a few years later, where they still live as one of the happiest, most peaceful and industrious colonies to be found anywhere in the world. Some of them still remain on Norfolk island. Both these islands are attached for government purposes to Australia. Norfolk island has an area of ten square miles and a population of 750, while Pitcairn island, with an area of three square miles, has a population of 120.

FRENCH ISLANDS IN THE PACIFIC OCEAN

All of the European colonial powers in the last century have become rivals for island possessions in the South Pacific ocean, although Great Britain is far ahead in the race for the tropical archipelagoes. France stands second in the contest, with some half a dozen island groups scattered throughout the Pacific. The best known of these French colonies are New Caledonia, the Marquesas islands, and Tahiti in the Society group.

New Caledonia was discovered by Captain Cook, the great navigator, who was afterwards murdered by natives in the Hawaiian islands. From the time of the discovery, in 1774, until the middle of the next century, it was apparently regarded as not a desirable island to steal from the natives. The soil offered but little inducement, and the presence of mineral treasures was not suspected. Some French missionaries had labored among the natives, and this gave the excuse to France for seizing and colonizing the island in 1853. The real purpose of the French in hoisting their flag here was to establish a penal colony for convicts, as England had done with Australia and Tasmania. The introduction of a criminal population made the work of the missionaries doubly difficult, but the convicts themselves, under the direction of the authorities, were required to cultivate the island resources so that the colony became somewhat productive and prosperous before many years had passed.

The area of the island is about 6,000 square miles, and its length from northwest to southeast is nearly 250 miles. Attached to it for government purposes are the Isle of Pines, the Loyalty archipelago, the Huon islands, the Chesterfield islands and the Wallis archipelago, all unimportant groups belonging to France in that part of the Pacific ocean. The population of New Caledonia is something less than 55,000, of whom the natives number nearly 30,000, the convicts more than 10,000, and the military about 1,500. Coal and other minerals are worked, rough ore, nickel, chrome and cobalt being largely exported to Europe and Australia. About 1,900 square miles are set aside for natives and colonists; 600 square miles of land suited for agriculture or pasturage remain uncultivated; the rest is mostly forest or mountain. Wheat, corn, and other cereals are cultivated, as are also pineapples, coffee, sugar, cocoanuts, cotton, manioc, vanilla, grapes and other minor tropical products. There are 125,000 head of cattle. According to French statistics, the annual trade of France with New Caledonia is about $4,500,000. The capital of the island is Noumea, with a population of 7,000. It is connected with France by steamship lines which pass through the Suez Canal and call at the southern ports of Australia before ending their voyage at Noumea. It also has a cable connection with the Australian continent.

The natives of New Caledonia are a strong, well-built race, dark in color, with short, curly hair. When discovered they were industrious and peaceable, although they practiced cannibalism. Captain Cook says: "They were courteous and friendly and not addicted to pilfering. They showed no fear of white men and never the slightest sign of hostility." Their soil being thin, they were forced to industry and careful cultivation, and raised the bread fruit, their chief food, with great success. The coast

TAHITIAN YOUTH WITH TROPICAL FRUITS.

The young man is carrying plantains, taro roots and pineapples, with bread-fruit at his feet.

natives are noted fishermen. The natives build high, conical houses of reed frames with close thatching of palm leaves. They are among the most peculiar dwellings that have been found in the Pacific islands.

New Caledonia lies about half way between New Zealand and New Guinea, and some 700 miles off the coast of Australia. Nearly 3,000 miles to the eastward are the other important French islands in the Pacific. There are a great number of small islands belonging to the French in this archipelago, of which Tahiti is the best known. It has an area of 412 square miles and a population of about 10,000. There is a governor for all of these smaller islands, who resides at Papeete, the chief town of Tahiti, and there is also a general council, elected by universal suffrage. The commerce of these islands annually amounts to nearly $2,000,000. The chief exports are mother-of-pearl, copra, cotton, vanilla, sugar, coffee and oranges.

Tahiti was the first Christianized of the South Sea islands, and is now a pleasant and peaceful place in which to dwell. Its center is a magnificent mountain system, and its fertile land is in the valleys that lie between the mountains and along the sea shore. The natives dwell in separate homes instead of in villages. They are of a race resembling the Hawaiians and are athletic and of a light brown color. Their mouths are large, noses somewhat flat and teeth very white and even. They dress well in a fine bark cloth, resembling paper. The climate is warm, but healthy. All the houses are lightly and airily built, the floors covered with mats, and the roofs thatched with palm.

A large part of the trade of Tahiti and the neighboring islands is carried on by way of the United States. The French government subsidizes a mail steamer which makes a trip once a month between San Francisco and the island capital, so that passenger and freight traffic is carried on in a regular and comfortable way. It affords one of the most attractive voyages into the tropics that any American traveler could select.

FIJI AND ITS PEOPLE

For many years in the early history of explorations in the Pacific ocean, and, indeed, until the middle of the nineteenth century, Fiji, to most readers, was a synonym of savage violence and cannibalism. Within half a century this island group has been changed from savagery to peace and order, as one of the prosperous colonies of the British empire. Fiji comprises a group of islands lying some 500 miles west and a little south of our own American island of Tutuila in the Samoan group. It is almost directly west of the Society islands, in which is the French island of Tahiti, and consequently well within the tropics.

The islands exceed 200 in number, about eighty of which are inhabited. The largest is Viti Levu, with an area of 4,250 square miles, or about the same as Jamaica. The total area of the group, however, is nearly twice that much. The capital, Suva, is on the south coast of the largest island, and is a prosperous and picturesque little city with a white population of nearly 1,000, in addition to the natives. The total population of the group is about 125,000, of whom the natives number about 100,000, the rest being divided between Europeans, laborers who have been imported from India, and other Polynesian islanders. Nearly the entire population has adopted Christianity, and the schools and churches are well attended. The principal products are sugar, bananas, cocoanuts and cattle, although other minor tropical fruits and vegetables are produced for home consumption. The annual exports are about $2,500,000 and the imports about half as much. The islands are administered by a governor sent given to Great Britain. The islands are visited twice a month by trans-Pacific passenger steamers sailing between Canada and the Australian colonies, and by other local steamers which connect them with Australia, New Zealand and Samoa. Although they are no longer isolated, they have not lost their picturesque forms of native life, and, accessible as they are, form

AN AFTERNOON TEA IN THE SOUTH PACIFIC, ISLAND OF TAHITI.

from Great Britain, an executive council and a legislative council. No military forces are kept in the colony, which is the best evidence that it is peaceable and orderly.

Under their native kings the Fiji islands were always engaged in internal warfare, and finally the last native monarch, Thakômbau, in 1874, yielded their independence and signed the treaty by which they were one of the most interesting places for tourists' attention.

THE ISLAND OF GUAM

The island of Guam, the largest in the Marianne or Ladrone archipelago, was ceded by Spain to the United States in 1898 as one of the results of the Spanish-American war. It is a fertile island, thickly wooded and well watered, about thirty-two miles long and 100 miles in circumference. The population of the island is about 9,000, of whom 6,000 live in Agana, the capital. The inhabitants are mostly immigrants, or the descendants of immigrants from the Philippines, the original race of islanders having become extinct. The recognized language has been Spanish for many years, but English is also spoken. On the island are eighteen schools, and seven-tenths of the islanders can read and write.

The island of Guam has a distinct value to the United States as a coaling station, a port of call, and a station for a trans-Pacific telegraph cable. About half way between Guam and the Hawaiian islands is Wake island, also belonging to the United States, and intended likewise as a station for the trans-Pacific cable. These three stations become very convenient as steps on the way between San Francisco and Manila.

The capture of Guam by the first military expedition sent from the United States to the Philippines in the summer of 1898 had some phases of humor about it. The people there had no knowledge that war had been declared between the United States and Spain, or even that hostilities were impending. When the ancient fort outside the harbor was bombarded they took it to be a friendly salute, and sent word out to the ships, apologetically explaining that they appreciated the courtesy, but had no powder with which to reply to the salute. Not until then did the governor know that he and his island were captured. When the ships sailed on to Manila they took with them the governor and other officials as prisoners, leaving the island affairs to be directed by the one American citizen who lived there, a young man of Spanish birth who had once lived in Chicago long enough to become naturalized.

TASMANIA, PAST AND PRESENT

Although seldom visited by travelers from the United States, the British island colony of Tasmania has a peculiar interest in its history and in its life and industries to-day, which makes it worthy of special attention. The island lies some 200 miles south of southeastern Australia, from which it is separated by Bass Strait. It is about the size of Ireland or Ceylon, and has a population of approximately 150,000. The island was discovered by Tasman in 1642, and by him was named Van Diemen's Land, in honor of the other famous Dutch navigator who had preceded him in Pacific explorations. The island was left untouched by the European colonial powers until the beginning of the last century.

In 1804 Great Britain established a penal colony there, and from that time till 1813 it was merely a place of transportation from Great Britain and from New South Wales, of which colony it was a dependency until 1825. The first free settlers found it the prison of the worst convicts from England and Australia. The most shocking brutalities were practiced on the helpless outlaws by their guards. Years went by, during which the island obtained shocking notoriety throughout the world for the horrible offenses practiced there. Finally the free settlers increased in number to such an extent that they were influential in inducing Great Britain to terminate the policy of criminal exile. Transportation ceased in 1853, and three years later the island was created a self-governing colony and the name was changed to Tasmania in order to escape the shadow that was associated with the older name.

Rudyard Kipling, in one of his poems, has characterized the past and the present of Tasmania in a quatrain of peculiar force and beauty:

"Man's love first found me; man's hate made me hell;
For my babes' sake I cleansed those infamies.
Eager for leave to live and labor well,
God flung me peace and ease."

So the island has become to-day one of the most placid, peaceful and happy of all the colonies of Great Britain. Its area is about 26,000 square miles, and its surface, in general, is mountainous, with the highest point, "Cradle Mountain," extending to a height of 5,069 feet. The Derwent, Esk and Huon are the most important rivers. The climate is mild and delightful, with an average summer temperature of sixty-two degrees, and in winter of forty-seven degrees. The rainfall is moderate and well distributed throughout the year, so that neither droughts nor floods trouble the people. There are extensive forests, abounding in beautiful cabinet woods and other valuable timbers. The cultivated area is approximately 550,000 acres, the chief products being wheat, oats and hops.

An important industry is found in the raising of fruit, and one great region in the southern part of the island is known as "Appleland," so numerous are the orchards. Inasmuch as fruit here in the southern hemisphere comes into bearing at a season just opposite in the year to that when our own fruits are ripe, and the fruit-producing regions of the south are limited in area, the people of Tasmania are assured of the very highest prices for all that they raise. During the season for apple shipments all of the largest steamers plying between Australia and Europe call at Hobart and take immense cargoes of these delicious Tasmanian apples to the markets of London and the continent. Other important exports are wool, gold, silver, tin and hides. Fruit preserving, also, is a leading industry. The tin mines are of great value, hardly second to those of gold and silver.

Tasmania is now one of the states of the Commonwealth of Australia. Its capital is Hobart, also the largest city, with a population of 25,000, while Launceston, with a population of 17,000, is the second city. Education is compulsory. There are thirteen superior schools or colleges in the colony, one university, two technical schools, and 450 public and private elementary schools. The little colony has forty public libraries and institutions of similar character, nineteen newspapers and other periodicals, and a postal savings bank. The railways and telegraphs of the island belong to the government, and are operated in the public interest cheaply and satisfactorily. The scenery of the island is picturesque and beautiful, being pastoral in the agricultural regions and rugged among the mountains. Tasmania is the home of the tree fern, which is cultivated as a plant of great beauty in our conservatories. Whole forests of it cover the mountain sides in this southern island which looks off toward the Antarctic ocean. There are said to be no rich people and no poor ones in Tasmania, but the whole population enjoys a reasonable degree of comfort and prosperity. This is the condition considered most favorable for true happiness in any community, and Tasmanians are well contented in their little island.

By Courtesy of the Santa Fe Railway.

THE GRAND CANYON OF THE COLORADO RIVER IN ARIZONA.

BOOK IV

AMAZING WONDERS OF NATURE

GREENLAND AND ITS GLACIERS

When the hymnist wrote of Greenland's icy mountains he embodied in a phrase the extremes which nature exhibits in that inhospitable land. Eric the Red, after being driven from Iceland for the murder of a brother chief, spent three years in exploring the more promising parts of Greenland, and, so grateful was he to this land of refuge, and so much brighter were the prospects here than in lava-stricken Iceland, that in contrast he gave it the name Greenland.

In 1901 there were but 309 persons of foreign parentage in Greenland, and the remainder of the inhabitants were natives fewer in number than ten thousand.

The center and the north and east are so covered with the ice accumulations of ages that no idea can be formed of the nature of the land. From the mountains there run down to the sea vast streams of ice which plow into the sea and become veritable ice-mountains, having indescribable elements of beauty. These great icebergs are cut into such forms by wind and water as to keep the imagination busy with colossal images—caverns that seem limitless, cathedral spires and gothic arches, zigzag clefts as if made by earthquakes, all with changing hues that defy the brilliant changes of the opal and the colors of the rainbow.

Usually a great river or roaring water pours from underneath the sea of ice. Sometimes the icy lake spreads out in a valley several miles across, in which the ice is a thousand feet deep, and then it moves on through a gorge cutting its way with irresistible power.

Denmark has never received much value from its possession of Greenland, and it is doubtful if this great island will ever contribute much more than it does now to the human race.

ICELAND AND ITS GEYSERS

Iceland is indubitably one of the most interesting spots on the face of the globe. Though as large as Ireland, it is in the interior a frightful desert; and it is only populated on its southwestern side by about 75,000 souls. Surrounded by stormy seas, which are generally covered with ice, this island,—with its tall, bare mountains, crowned with eternal snows and ice; its numerous precipices; its enormous lava fields, and the ever-present traces of frightful earthquakes and desolating eruptions; without a tree, and, with the exception of the seaboard valleys, without vegetation,—produces a startling effect on the traveler.

The geyser district lies at the foot of a steep but not very lofty hill, in a plain about ten miles in width, doubtless the bed of an old fiord, which runs down to the sea, and resembles an outspread green carpet of marshy pasturage. It is watered by the Tugn flyot and several smaller streams, which fall into the Hvita at the end of the valley. In the northeast the plain is bordered by the Blafell, a lofty extinct volcano, whose summit is partially veiled by clouds, and whose steep sides, denuded of all vegetation, display caverns and ravines filled with masses of snow. Round the plain are also other masses of jagged mountains, which, in the interior of the island, are piled up in gigantic forms; while Hecla, covered with its mantle of snow, proudly looks down upon the whole scene. The elevation of the springs above Reykjavik is, according to Bunsen's calculations, about 360 feet. The principal springs are situated here close together, the two extremes being hardly 600 feet apart.

The most noted of Iceland's geyser springs is that of Strokkur. Preceding each eruption there is the hollow sound of some vast drum struck by a thunderbolt, then a mighty pillar of steam and spray rises with incredible force to the clouds. Following this a solid body of water rises to the height of 800 or a thousand feet. This eruption rarely occupies more than six minutes.

The population of Iceland is quite stationary at 75,000, and their exports are chiefly sheep, wool, dried fish, oil, eider down, moss and seal skins. The only wild animal is the arctic fox.

"OLD FAITHFUL," A GIANT GEYSER OF YELLOWSTONE NATIONAL PARK.

THE GREAT LAVA DESERT OF ICELAND

In the central region of North Iceland is the most extensive solid lava desert in the world. On clear days the inhabitants living at the edge of the rocky tract of barrenness can see in the great distance thin streams of smoke arising as if from the chimney-tops of a city. This has established a firm conviction in the minds of the natives that a strange race of beings inhabit fertile valleys that lie between the volcanic peaks. The country abounds in stories of adventures with those imaginary people.

In 1876 the Danish government sent a scientific exploring party over the wastes and the myths were exploded as far as the more intelligent class of persons was concerned. However, the lava bubbles and volcanic outbursts have left such curious shapes and figures all over the dreary wastes that, if the imagination is allowed the least freedom, almost anything from the most hideous prehistoric creatures to well-arranged modern cities can be conjured up through the naked eye. Though a good field glass may dispel the given illusion, at the end of the range of the glass there will be another fully as startling.

THE GULF STREAM

Among the wonders of physical geography few are more interesting in their relation to this country than what is known as the Gulf Stream. This is an oceanic current of great extent, which takes its rise in the Gulf of Mexico, whence it derives its name. The peculiar formation and position of this gulf render it a receptacle for the waters of the Atlantic, which sweep across the northeastern coast of South America; and, on arriving in the Gulf, they become warmed to a much higher temperature than is anywhere found in the surrounding ocean. The summer temperature of the waters in the Gulf is about eighty-eight degrees, while in the open Atlantic, in the same latitude, it is only seventy-eight degrees.

Thus warmed, the waters pass out of the Gulf northward, in a deep and strong current, between the coast of Florida on the one side and the islands of Cuba and the Bahamas on the other. The stream progresses here with a velocity of five miles an hour. It rolls like a mighty river along the shore of North America, widening as it flows, until it nears the banks of Newfoundland, where it is turned aside, partly by the formation of the coast, which here projects boldly out, and partly by the encounter with strong and adverse currents from the North Atlantic. At the point where it is turned aside it stretches almost across the Atlantic; the current itself, according to some, being about two hundred miles in width, and the warm waters of the stream extending in all more than twice that distance. In the latter part of its course it leaves behind it that remarkable drift of sea-weed known as the Sargasso Sea.

Crossing the Atlantic eastward, towards the islands of the Azores, the main stream gradually becomes lost, and its current spent; but a portion of it continues northward towards the British Islands. Long after the current itself is lost the neighboring seas continue very sensibly affected by the warm waters which it has brought down.

It is important to bear in mind the distinction between the actual current of the

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FAMOUS FOUNTAINS OF PALESTINE

AMERICAN TOURIST PARTY IN PALESTINE.

softly." It was to this pool that Christ sent the blind man to be healed.

A church was built over it in the middle ages, but it was destroyed by the Mohammedans. On its banks stands a mulberry tree said to mark the spot where the prophet Isaiah was slain by Manasseh.

In a shallow vale by the Jaffa gate beyond the olive groves near Jerusalem is Birkeh el Mamilla, which was known as the fountain of Gihon to which Solomon rode on King David's mule, when Zadok the priest took the horn of oil out of the tabernacle, and annointed Solomon, as the people cried, "God save King Solomon." Near by this ruined fountain is the potter's field bought with the blood money of Judas.

Over toward Jericho is the fountain of Elias, much famed for its healing power in bible times; further on in the fertile valley of Kedron, on the boundary line between Judah and Benjamin, is the most famous pool of modern Palestine. Its Arab name means Fountain of the Mother of Steps. The Jews call it En Rogel; that is, to tread, from the custom of treading linen in the water. This pool is 360 feet in length and 130 feet in width. Here is where Jonathan remained when he sent the little maid to bear a message to David, who had fled from the power of his son Absalom.

It was from the Roman tower Antonio, near by, that St. Paul made his memorable speech to the Jews. This tower is still standing, though half in ruins. Here St. James was slain.

The Christians have named this the Fountain of the Virgin, for here the mother of Jesus came with other Jewish girls to cleanse the linen. To this day the beautiful stream of pure water flowing from this spring is used for the same purpose, and troops of large-eyed oriental girls are seen working about the pool and stream just as has been done here by the girls of Jerusalem for two or three thousand years.

SAGHALIEN, A PARADOX OF CLIMATE

Saghalien belongs to Russia, and is separated from the mainland of Eastern Asia by the Gulf of Tartary.

The island is bathed by two cold ocean currents, and in winter nothing protects it against the icy northwest winds coming from Siberia. At the sea level the snow falls continually, and stays on the ground till the end of May, and the seashore is very cold. Further inland, however, especially as we go higher up, the climate is modified —just the opposite to what is observed elsewhere. It has often been observed in Siberia and in Central Europe that in winter the cold is greater in the plains and the valleys, and that the highlands have a sensibly milder temperature; it is as if the denser cold air accumulated in the lowlands. This fact is very often observed in our climate; there are several very good examples of it; all the trees and shrubs of a valley have been known to be killed by frost, while above a certain level, very clearly marked out, on the hill or the mountain, the vegetation has not suffered at all. The cold air often flows from the summits toward their bases. This is what takes place at Saghalien. The cold air accumulates in the low regions of the island and on the coast; the higher regions have a more elevated temperature. So it happens that the lower parts have an arctic vegetation, while the intermediate altitudes have the vegetation of a temperate zone, sometimes almost sub-tropical. The birch, the ash, the pine, the fir abound in the low regions and form often impenetrable forests, but toward the center of the island appear bamboos, hydrangeas, azalias and other plants that one is greatly surprised to meet, and whose presence can be explained only by the altogether abnormal climatic conditions of the island.

THE ARABIAN DESERT

Arabia meets Palestine on the north, and from these lands have flowed the influence of Moslem and Christian well-nigh covering the world. As Jerusalem is the sacred city of many millions of Christians, so is Mecca the sacred city of many millions of Mohammedans. Not only have two of the great religions come from this small territory of habitable land, but it was once the garden from which came the seed of civilization.

Poets have sung of these lands, romancers have written of them and pious priests have glorified them till in our imagination they are the realms of pearl and amber, redolent with the fragrance of aromatics, spices, frankincense and myrrh.

The poets have been the geographers, and on epic authority we are assured that it is a paradisiac region laden with the inspiration of divine perfumes.

"To them who sail
Beyond the Cape of Hope, and now are past
Mosambic, off at sea northeast winds blow
Sabean odors from the spicy shores
Of Araby the blest; and many a league,
Cheered with the grateful smell, old Ocean smiles."

Here in truth is the dream-land of the world, replete with scenes made awesome through sacred song and story.

Strange remnants of Christian and Moslem occupation still remain almost unchanged.

About nine days of camel travel into the desert from Suez brings the traveler to one of these remnants, a spot of impressive loneliness and desolate grandeur at the foot of Sinai. It is the convent of St. Catherine, made like the stronghold of a castle with battlements on which are mounted ancient guns. The approach of strangers is guarded with all the ceremony of medieval times, when the least relaxation of caution or vigilance might mean destruction. Those approaching come up through the groves of cypress trees to the massive stone walls, where there is nothing but silence and no moving creature is to be seen. Back of the convent the perpendicular sides of the rocky cliffs rise to the height of a thousand feet and add to the solemnity of the scene.

After repeated calls a port hole is opened about 30 feet above the heads of the visitors, the face of a monk appears, and, after surveying the visitors stolidly for a few minutes, he lowers a rope from a windlass.

The letter of introduction from the convent at Cairo, which is indispensable, is fastened to the cord and it is drawn up.

This much of the customs has yielded to the improvement of government and the safety of modern times; they no longer draw the visitors up by the windlass, but after reading the letter a gate is at last opened and the visitor allowed to enter the court. Moses being a holy man alike to Christians and Mohammedans, there are both chapels and mosques about the place where the commandments were given. However, with sectarian perversity the Christian has decided on one mount as the scene of the handing down of the law to Moses and the Mohammedans another. Mount Horeb is the one generally agreed upon by Christendom.

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THE GREAT TREES OF CALIFORNIA

All the world has heard of the big trees of California, and those astonishing groves of forest giants which have attracted strangers from far and near to view their wonders. California is a state of great things, with its coast-line as long as that which stretches from Massachusetts to Georgia, its mountains which are surpassed on this continent only by a few Alaskan peaks, its gold mines, its orange groves, and its smiling valleys devoted to farming, all rivals in magnitude as the sources of greatest wealth, and its Yosemite Valley with the great cataract that plunges 1,500 feet sheer in one of its three downward leaps and its colossal domes, spires and arches of pure granite, contrasted with soft tones of green forest and silver lake. Of all these wonders the great trees themselves of the Mariposa and the Calaveras groves are, perhaps, the most conspicuous and the most widely known objects of curiosity. They are the oldest living

TWO GIANTS IN COMPARISON.
Masonic Temple, Chicago, 302 feet in height and Big Tree, 400 feet high. This ingenious picture, in which the artist shows one of the big trees apparently growing in a city street, depicts how nature's work overtops that of man.

things in the world. The best scientific estimates place the age of the oldest at about 5,000 years, and thus make them survivors of the Miocene period. It taxes the imagination to conceive the age that this means and the natural history of our globe which these grizzly giants have witnessed. With the danger of their complete extinction threatened as it seems to be, they become doubly interesting to us all.

Students of the groves declare that these big trees of California are not akin to any other trees now growing, except some of their own neighbors. Only by comparison with certain fossil remains of cone-bearing trees was the proper relationship found, and the kings of the forest were discovered to be species of the genus Sequoia. In deference, therefore, to the name of our greatest citizen these greatest of trees were named Sequoia Washingtoniana. Popularly speaking, however, the name Sequoia Gigantea has come to be accepted as the characterization of these monsters.

It was just about the time of the rush of the forty-niners to California in the days of gold discoveries that these trees were found. According to the scientists, the Sequoias covered great areas of America and Europe, far back in the mysterious, moist days of the Miocene period when all vegetation took strange, gigantic forms. When the age of ice came and our continents were swept by the glaciers that have left their tracks in every direction some of these ancient forms of vegetable life were exterminated, some were left as fossils and a few have come down to us in visible forms upon the surface of the earth as living things.

These two groves of big trees may be considered as small islands, upon which they were left in safety after the great upheavals of nature that passed around them. Here they have survived through all intervening thousands of years, so that today they have the distinction of being virtually the only survivors of a geologic age that is past. In addition to the two most famous groves, the Mariposa and the Calaveras, there are some other tracts in California which contain groves of Sequoias, although not the largest ones. Altogether there are 200,000 or 300,000 of the species, but of those remarkable for their great size not more than 500.

A common height for the pines, firs and cedars, which grow in the same forests, themselves noteworthy specimens of their own variety, is from 175 to 200 feet, but these are overtopped at least a full hundred feet by the big Sequoias that grow beside them. There are trees in the Mariposa groves which are nearly thirty feet through, and a great many between ten and twenty feet. Inasmuch as the largest trees are still standing, it is impossible to count their rings and measure their age exactly. But one tree that was cut down was found to be 2,200 years old, and another that had fallen to the force of the winds showed an age of 4,000 years. It is a fair estimate, therefore, that the larger ones still are at least 5,000 years old, and this agrees with the calculations as to the period whence they date.

Mr. John Muir, who has studied the trees and mountains and glaciers of the west with affectionate energy, calls attention to the vitality and vigor of these trees, and the fortunate way in which nature has protected them. The bark is thick and fibrous, and all but fireproof, so that forest fires have not been able to destroy the trees. The wood, too, does not decay, and fungus does not, therefore, thrive upon it. Even the trees that have fallen have lain sound for centuries.

The threat of extinction of the great trees comes from two causes. They are not inclined to rear new trees from seedlings, to reproduce their own groves, and the fine old trees themselves in many instances have been attacked by the lumbermen holding the land upon which they grow. The Mariposa grove is now owned and protected by the State of California, and there is an effort under way to purchase the Calaveras grove as a government park. But by far the greater number of the big trees are on land owned by the lumber companies, and many of them are at work on the Sequoia timber. The people of California are becoming aroused to the great value of these forest giants, as sources of interest for the tourists who flock to their state, and it is to be hoped that the vandalism which is threatening the existence of some of the finest specimens will be put an end to by the influence of public opinion and the purchase of the property for permanent preservation. The wood is not particularly valuable as timber, and it seems a manifest truth that the big trees, considered entirely as an investment for the state, would yield more as living curiosities than as lumber piles.

HOW GLACIERS AND ICEBERGS ARE MADE

Great mountains of snow and ice, which float down into the North Atlantic Ocean from the Arctic regions to threaten the safety of vessels crossing from America to Europe, are among the most peculiar and interesting of the works of nature. The land of their birthplace in the far north is not reached by many travelers, except the Arctic explorers themselves, but instead of the traveler coming to the iceberg the iceberg comes to the traveler, thus reversing the famous experience of Mahomet and the mountain.

The coasts of Greenland are the birthplace of the greatest icebergs that come into the Atlantic Ocean. They are produced from the glaciers which fill the valleys of this frozen land.

The story of the glaciers, from which icebergs are but offshoots, is an interesting one. A great weight of snow pressing downwards through crooked mountain valleys is squeezed between the rocky walls and gradually converted into ice. The great body of the glacier, which is neither snow nor ice, but both, creeps along and molds itself to its bed. But in changing its shape and slope its surface is broken by deep crevasses, which begin as simple cracks. These crevasses are caused by the tension or pull of the lower mass of ice upon the upper, and consequently they generally occur transversely or obliquely up-stream. Dirt accumulates in the crack until the whole mass closes by being pushed into a new position. Elevations in the bed of the glacier thus leave a permanent record in the ice which breaks above them. This record is carried on the center of the stream, which moves faster than the margin, and consequently these dirt-lines, which mark the former crevasses, gradually become bow-shaped, until they almost touch each other at the margin. Viewed from above, the effect is very striking, and these dirt-bands, as one may call them, appear sometimes like the graining on a slab of oak. When the crevasse fills with snow instead of dirt the bands are white instead of grey. The newly-fallen snow on the mountain tops is gradually made firm by pressure. Slowly, almost imperceptibly, it begins to glide down the slopes; air, before imprisoned, escapes, and the snow hardens. After a time the mass reaches a steep slope, confined in a valley, and then pressed down from behind and from the sides, it changes into clear, blue ice, streaked with little veins where the air has not been expelled. And so a little tongue of ice begins creeping down the valley until it swells into a great river, terminating in a vertical wall hundreds of feet in height. As the long, sinuous band of ice continually creeps down from the mountains the topmost portion moves faster than the ice below, and finally a piece breaks off, either on the mountain side or in the sea, if the flow has traveled so far. In this way the smaller icebergs are formed.

"Calving" of icebergs, as the breaking off of blocks from the parent glacier is called, is produced by the action of the tide. Upward and downward pressure, exerted by water at the rise and fall of the tide, on submerged portions of the glacier front, forces off a strip of ice, which floats away as a berg.

The Humboldt Glacier, sixty miles in length, is the most celebrated in Greenland, and has a perpendicular face of 300 feet. The glacier was discovered by Dr. E. K. Kane, U. S. N., in 1853. We take the liberty here to quote from Dr. Kane's book, "Arctic Explorations," his striking description of it. "My recollections of this glacier are very distinct. The day was beautifully clear on which I first saw it, and I have a number of sketches made as we drove along the view of its magnificent face. They disappoint me, giving too much white surface and badly fading distances, the grandeur of the few bold and simple lines of nature being almost entirely lost. I will not attempt to do better by florid description; men only rhapsodize about Niagara, and the Ocean. My notes speak simply of the 'long, ever-shining line of cliff diminished to a well-pointed wedge in the perspective,' and again of 'the face of glistening ice, sweeping in a long curve from the low interior'; the facets in front of the cliff rose in solid glassy wall three hundred feet above water-level, with an unknown, unfathomable depth below it, and its curved face, sixty miles in length, from Cape Agassiz to Cape Forbes, vanished into unknown space at not more than a single day's railroad travel from the Pole. The interior with which it communicated, and from which it issued, was an unsurveyed mer de glace, an ice-ocean to the eye, of boundless dimensions. It was in full sight—the mighty crystal bridge which connects the two continents of America and Greenland. I say continents, for Greenland, however insulated it may ultimately prove to be, is in mass strictly continental. Its least possible axis, measured from Cape Farewell to the line of this glacier, in the neighborhood of the 80th parallel, gives a length of more than twelve hundred miles, not materially less than that of Australia from its northern to its southern cape. Imagine, now, the center of such a continent, occupied through nearly its whole extent by a deep, unbroken sea of ice, that gathers perennial increase from the water-shed of vast snow-covered mountains and all the precipitations of that atmosphere upon its own surface. Imagine this, moving onward, like a great glacial river, seeking outlets at every fiord and valley, rolling icy cataracts into the Atlantic and Greenland seas; and having at last reached the northern limit of the land that has borne it up, pouring out a mighty frozen torrent into unknown Arctic space. It is thus, and only thus, that we must form a just conception of a phenomenon like this great glacier. I had looked, in my own mind, for such an appearance, should I ever be fortunate enough to reach the northern coast of Greenland. But now that it was before me, I could hardly realize it. I had recognized, in my quiet library at home, the beautiful analogies which Forbes and Studor have developed between the glacier and the river. But I could not comprehend at first this complete substitution of ice for water. It was slowly that the conviction dawned on me that I was looking upon the counterpart of the great river systems of Arctic Asia and America. Yet here were no water feeders from the south. Every particle of moisture had its origin within the Polar circle, and had been converted into ice. Here was a plastic moving, semi-solid mass, obliterating life, swallowing rocks and islands, and plowing its way with irresistible march through the crust of an investing sea."

The glaciers from which the bergs break off crop out all along the Greenland coast. On the other side of America, on the Alaskan coast, are other great glaciers, one of them, the Muir Glacier, being frequently visited by summer tourists in excursion parties up the Alaskan coast. But these Alaskan glaciers do not send their iceberg children far down into the track of vessels in the Pacific Ocean, as do those of Greenland into the Atlantic.

Up to the middle of August travelers crossing the North Atlantic are very likely to see the fragments of these great mountains of ice which have floated down from Baffin Bay and have not yet entirely melted under the influence of the warm weather. During some seasons these icebergs form a source of considerable danger to ships, and more than one collision between a great Atlantic liner and these navigators from the Arctic have been reported in the list of marine disasters in recent years. Frequently the icebergs bring with them a local fog which screens them for miles around like a low hanging cloud. This results from the contact between the warm, moist air rising from the ocean, and the cold rays radiated from the great body of ice. When a ship enters a fog in the North Atlantic, at such a season, the navigator watches for icebergs quite as carefully as for other vessels. He has two sources of warning when danger threatens. From the iceberg itself, the sound of the steamer's whistle is echoed back to him so that he may judge the direction of the berg and may estimate its distance by the time required for the return of the echo. As he draws nearer, steaming slowly through the fog, a delicate thermometer prepared for the purpose on the bridge of the vessel, responds to the cold given off from the frozen mass, and the mercury falls rapidly. It is at such times that the skill and caution of an able navigator are displayed.

Let us trace the history of one of these great icebergs from the time it has broken loose from the parent glacier to float away into the waters of Baffin Bay, Davis Strait and Smith Sound. Seven-eighths of the weight of the iceberg is under water and one-eighth of it above. When we see an iceberg which extends a hundred feet, or, perhaps, much more above the water, we know that it is practically seven times as great below the surface. This suggests the enormous mass of ice and indicates the danger which it threatens to a colliding vessel. The current acting upon this mass under water causes irregular pieces to be detached. Thus the balance of the berg is changed, and it turns over sufficiently to restore its equilibrium, with the heaviest part once more hanging downward in water. It thus floats, moving with the current generally southward, the sun's rays, wind and frost changing the exposed surface and the outline of the berg itself. When the warmer currents of water are reached in lower latitudes melting takes place, till the bergs finally disappear altogether in the Gulf Stream.

It is this melting of icebergs as they move southward into the warm water that has built up from the floor of the ocean that remarkable tract known as the Grand Banks of Newfoundland. The glaciers of Greenland carry with them as they move toward the sea great quantities of stone and sand, gathered as debris from the mountain valleys where they were formed. The icebergs breaking away from the glaciers and floating southward into the Atlantic carry with them these same fragments, and as they melt ultimately deposit the debris upon the floor of the ocean. This process continuing through centuries upon centuries, they have built in the Atlantic a great plateau, surrounded by deep water, rising within a few hundred feet of the level of the sea. This peculiarly submerged plateau lying to the southeast of Newfoundland covers an area of some 200 by 400 miles. On these Grand Banks are the favorite fishing grounds of the fleets that sail from Massachusetts and Newfoundland every year for cod and mackerel. The greater Atlantic liners usually pass to the south of the Grand Banks in order to avoid the fogs, the icebergs and the fishing vessels which obstruct the more northern route. But in early summer the tourist on a vessel sailing from a Canadian port and crossing the Grand Banks can hardly fail to have the pleasure of seeing one or more of these great travelers from the Arctic, as well as numbers of the fishing schooners themselves, working in these shallower waters.

We observe that the ice of the bergs looks like great masses of chalk or loaf sugar, varnished, if you please, or glistening like powdered glass. At times it is pure white, at others it looks greenish, and we note that this greenish tone is caused by the reflection of light upon masses of ice under water, thrown back upon the exposed surface. The shadow side, away from the sunlight, is a beautiful blue, traceable to the reflection from the sky. We also see icebergs of a beautiful blue color, and these are built up of ice formed from fresh water, the water melting upon the surface of the glaciers, due to evaporation, rain and melting snow, being different from ice or frozen water, containing salt, in that being much thinner or porous, it absorbs light. Charming cobalt blue bands are sometimes seen running through bergs, and these are the streams of fresh water frozen before the berg was formed, invaluable as the fresh water supply of the Arctic ships.

Let us look at that great glacier with irregular front, as high as a six-story house, with a length of a mile and a half. We are steaming about four miles away, and the day is beautifully clear, with bright sunshine. The air is crisp, like one of our winter days, the water calm as a mill pond, and a great silence reigns. Floating pieces of ice called floebergs and icepans, with a seal lying asleep upon them, float by. Arctic birds, the puffin, eider duck, mollomokes and kittiwakes, fly past; a charming tranquillity rests over all and we feel at peace with all the world. A great boom is heard, like the report of a big gun, echoed and re-re-echoed till it dies away. We look toward the glacier. A mass of the ice, as large as eight city houses, is slowly detaching and sliding away, sinking, sinking very slowly, pushing in front of it a high green wave of water, which approaches like a wall. As we look the mass turns over, and as a portion rises the water is thrown off in a great cataract. The mass sinks out of sight, now it rises again. It rocks from side to side, sinks again, nearly out of sight; rises again, turns a little, and thus for twenty minutes it keeps moving. The waves have reached our ship, and we rock, heave and dip under their influence. At last the berg has settled quietly, and is floating with the tide. A beautiful blue cave is visible, a great turret at one end, a sloping mass rising toward the opposite. A great concave channel slanting along its base shows the former action of the water line. This berg will float southward, gradually melting, changing its form, becoming smaller, and finally mingling with the waters of the Atlantic. Thus an iceberg is born and dies.

TRINIDAD AND ITS BITUMINOUS LAKE

Columbus discovered Trinidad in 1498,

THE GREAT ASPHALT LAKE OF TRINIDAD.

and gave it that name because of the three mast-like mountains on it which appeared to rise directly out of the sea. With the island of Tobago it forms the British crown colony of Trinidad. Trinidad has 1,754 square miles and its chief town has the singular name Port of Spain. At the nearest point it is only 9 miles across the Gulf of Paria to the mainland of Venezuela.

Near the village of La Brea is a strange fresh-water lake of about 300 acres, the surface of which is covered with pitch. The asphalt bubbles up in the center and hard-

Nothing alive can brave the hurricane. The man who will keep close within a tent, with his head wrapped in a blanket, will survive, but he will suffer with the heat almost as severely as if in an oven, and for days thereafter with pain from smarting nostrils and inflamed ears and eyes. Old-time plainsmen who know about all the hardships a man's anatomy can experience, are a unit in saying that the desert sand storm, more particularly a Death Valley sand storm, is the most trying physical ordeal. The mountains which bulwark Death Valley show the terrific erosion of their flinty faces by successions of these tempests. Here and there are starved grease-root plants, like stunted, starved trees that have been half-buried in the sand during these storms. Many a man who has been a desert teamster or a mining prospector has suffered chronic inflammation of the eyes by reason of having experienced one of these whirlwinds of alkali sand.

The nearest water course to Death Valley is the Amargosa River, a little stream that trickles down in an enormous bed from away up among the mountains in Nevada. Centuries ago the Amargosa was a mighty, roaring torrent that eroded granite rocks and ate a river bed half a mile wide for over eighty miles. The Amargosa touches the extreme southwestern end of Death Valley, and in this locality lizards and venomous crawling things may be occasionally seen darting from under the rocks. In the same locality tiny rivulets of heavily charged borax water issue from the base of ancient volcanoes and form in pools. Hundreds of acres of the purest borax are created here by the intense evaporation, and large fortunes have been made by Californians, who haul the product across the desert to the railroad station in Mojav

Death Valley gets its name from i ghastly aspect, its desolation, and its deadl effect upon many a venturesome or ign rant mining prospector who has attempte to cross it in the summer, and who has die of thirst there. Among all the tales of gri hardships and dreadful suffering by em grants to California before there were rai roads west of the Missouri River, none so pitiful as that of the party who got lo in Death Valley in 1849. There were fiv hundred emigrants in a caravan at Sa Lake City in August of that year. A were going to the gold fields of Californi A division of opinion arose as to the safe and easiest trail across the trackless plain and the Sierras to the new El Dorad Some two hundred of the party struck ou for the southeast and found the old Sant Fe trail, which finally led them to souther California. The rest went plodding in caravan across the wastes of southern Utal There was nothing to show them the wa through the lifeless, roasting valley, pas the bald mountains, and then westward ove the towering Sierras.

The caravan was in the land of thirst For four months the starving, half-craze men and women wandered hither and yo through the region of horror, seeking som pass between the mountains to the Pacifi Ocean. Mirages led them vainly awa from the trail. Their wagons fell apar from dryness, and horses daily fell unde the withering heat. The oxen fell, an the stalwart men sickened and died in th camps. One day nine young men becam separated from the main party, and year later their whitened bones were found i an extinct volcano crater, where they ha crawled in their delirium and weakness

For days the gaunt, weak men in the party went without food. The days were too hot to be out in the sun, and they confined their efforts to the nights for finding paths that might lead out of the roasting tomb.

At last eighty-two of the original party —now mere skeletons and so weak they could scarcely walk—found a passageway through the Funeral Mountains, and summoning all their little remaining strength, managed to get up and out of Death Valley into the cool and well-watered region of southern California, beyond the Sierras. One of the party, the Rev. J. W. Grier, weighed 188 pounds when he left Salt Lake City, and when he reached Los Angeles eighteen weeks later his weight was down to 92 pounds. Two of his brothers and one of his sisters-in-law died during the awful journey.

The story of the destroyer is not told without an account of Lieutenant Wheeler. Wheeler was a young officer fresh from West Point, who, immediately upon his graduation, in 1870, was assigned to a one-company post in western Nevada. After going through the loneliness of a Nevada winter in his little post, under direct command of his captain, a former West Point instructor, with whom he had quarreled at the academy, Wheeler came to an open personal breach with his captain in the spring and vowed henceforth he would speak no words to his superior other than those enjoined upon him by the military regulations. The captain, resenting his subordinate's silence, piled upon him every disagreeable, onerous and unnecessary duty conceivable.

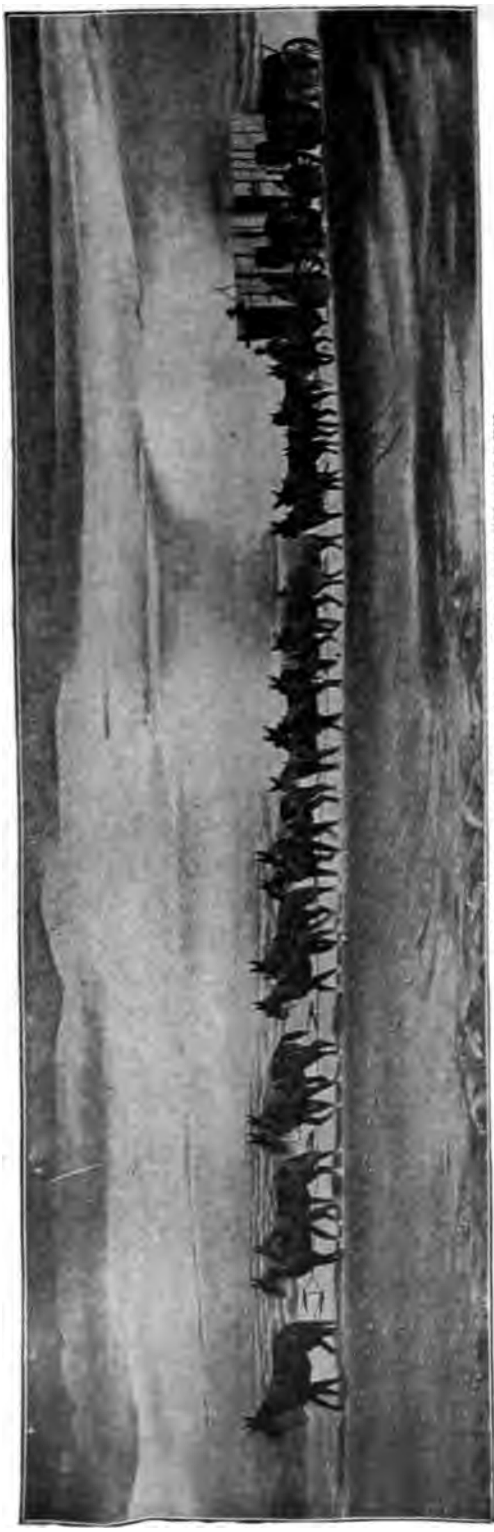
In July, 1871, his captain ordered young Wheeler to take two men and search for the most direct path across Death Valley. Wheeler marched off in the direction of the mantrap, and when he arrived at the edge of the valley of destruction he sought a guide. A halfbreed Mexican and Indian volunteered for $20 to steer the party across. "Here is your money," shouted Wheeler, "and now I'll hold you to what you said. Start across."

The halfbreed, frightened at the earnestness of the man whom he had expected to hoodwink, began to back and fill on his offer. "Fix bayonets," ordered Wheeler to his two men. They did so. "Now march that man across that pit in front of you."

Toward nightfall the three started, the two soldiers with fixed bayonets, the guide in front of them. The next morning the two soldiers came back separately. One was utterly raving and permanently insane. The other, suffering from sun-stroke, drank a few drops from Wheeler's canteen, then lay down to rest in a boulder's shade. In the afternoon he was dead. Wheeler was never sane after his all-night vigil waiting by the side of Death Valley for his two men to come back. The guide wandered off from the two soldiers and was never seen alive again, although his wife identified his bones the following winter by means of a string of beads which he wore around his neck.

BORAX AND ITS PRODUCTION

Every man who went to California in the early '50s hoped to have a gold mine of his own, where he could settle down and become as wealthy as a national bank with little or no exertion. But unfortunately nature has not provided enough gold mines



TEAM OF TWENTY MULES HAULING BORAX FROM DEATH VALLEY.

Wagon wheels 7 feet and 5 feet in diameter; hubs 18 inches and 22 inches long. Tires 8 inches wide, 1 inch thick; steel axles 3½ inches in diameter; bed 16 by 4 feet, 6 feet deep; weight 8,000 pounds; capacity 20,000 pounds; water tank wagon in rear.

to go all around. Consequently it was not long before the country was flooded with a tatterdemalion swarm of men, half miners, half tenderfeet, who, instead of being their own millionaires, were seeking an opportunity to relieve the ache under their belts. They were also bent on discovering something—that is what they had come for—and if it couldn't be a gold mine it might be a silver mine, a diamond drift or anything—they cared very little what. And that is how the vast borax deposits of the region came to be unearthed.

Previous to that time borax came mostly from Asia, and it was an expensive and little known commodity, sold from some small glass bottle on the apothecary's shelf. But within ten years after the time the disappointed gold miners found the deposits of borax it had become almost as common as table salt. Today the work of digging, transporting and refining it has grown to be a vast industry.

Borax was discovered out west by a man with an idea. Dr. John A. Veatch was a good deal of a geologist, and when he went west to look for gold and saw the vast stretches of parched and bitter alkaline plains he concluded from his knowledge of rock formations that borax could be found somewhere in the region. So he began to look for it deliberately, and one day early in 1856 his prospecting spade struck a small deposit in a dried lake bottom. It was not worth much, but it set a great crowd of miners peering about in the hope of finding better deposits. A few years after, some prospectors discovered that the bottoms of several California lakes were full of borax crystals, and from mining in the earth they began pumping water out of huge caissons set in the mud and then digging the earth up inside them and washing out the crystals. Although the borax thus found was not pure it could be used for manufacturing fluxes of various sorts, and the substance was greatly cheapened.

But the greatest discovery was made in that great, hot region, "Death Valley," in California. It was made in a most romantic way. In 1880 Aaron Winters lived with his wife, Rosie, in a gulch known as Ash Meadows, not far from the deadly mouth of Death Valley. He was so fond of his wife that he would not allow her to be long absent from him, although their little hut on the side of the mountain was 100 miles from the nearest neighbor in a wild, rugged, forsaken country. One day a desert tramp came along and stopped over night at the Winters home and told the hunter about the borax deposits of Nevada. When he went away Winters thought that he had seen deposits of the kind described on his explorations down into Death Valley. Accordingly the strange couple went together to make the search, having previously provided themselves with certain test chemicals, which, when combined with borax and ignited, would produce a green flame.

Having procured a piece of the substance which he believed to be borax, Winters and his wife waited for nightfall to make the test. How would it burn? For years they had lived like Piutes on the desert, entirely without luxuries and often wanting for the very necessities of life. Would the match change all that? Winters held the blaze to the substance with a trembling hand, then shouted at the top of his voice: "She burns green, Rosie! We're rich! We're rich!"

They had found borax. The mine was sold for $20,000, and Winters took Rosie to a ranch in Nevada, but she could not stand prosperity, and a few years later she died.

Borax crystals are no longer dug even in California and Nevada, because the substance has been found in much more convenient form for refining in combination with lime. In this state it occurs in mountain strata, and it has to be mined exactly like silver or copper, but the cost is far greater. In the first place the region is totally destitute of water and fuel of any kind, both of which have to be transported long distances. Indeed, so dry is the country that workmen frequently go insane, and both men and horses perish miserably from thirst if water is not kept constantly at hand.

Besides all of the difficulties, accentuated by the necessity of having the finest machinery and skilled labor, all of the ore has to be transported for scores of miles over the desert before it reaches the railroads.

This work is mostly done by the aid of huge wagons with broad-tire wheels, weighing about 8,000 pounds each and having a carrying capacity of 20,000 pounds. To each wagon several teams of horses and mules are hitched, and the long trip across the desert and through perilous mountain passes begins. One of the wagons in the train is provided with a tank of water, for it would be impossible to travel without it. The drivers are rugged, fearless men, partaking of the characteristics of the country. They can swear as artistically at their mules as any teamsters in the world, and can drink as much whisky, but they are withal a hearty, hospitable set.

On reaching the railroad the ore from the great wagons is loaded on box-cars and transported several hundred miles to the refineries, one of the largest of which is located on San Francisco bay. Here the rough, broken masses of brown rock are unloaded at the door of a long, shed-like building, and the process which is to transform it into beautiful crystals of borax is soon under way. The crude material first passes between the jaws of a rock-breaker, from which it comes out in small, pebble-like pieces. Then it goes into the hopper of a machine not unlike an old-fashioned buhrstone flour-mill, where it is thoroughly pulverized. It now has about the appearance of buckwheat flour, and is ready for the final process of separating the borax.

To accomplish this it is thrown into a great steam chest or pressure boiler, called a digester, and carbonate soda in a fixed proportion is added. When heat is applied in the furnace below and the mass within the boiler is churned with plungers, the digestion in the big stomach begins. The carbonic acid in the carbonate of soda suddenly deserts the soda, and unites after many spurts and fizzings with the lime in the borax ore, which is nothing more than borate of lime. Then the boracic acid in the ore finds more attractive company with the deserted soda, and in the united state becomes bichlorate of sodium, which is only the aristocratic name for borax. It is still in solution, however, and as soon as it cools off it is run into great vats filled with a myriad of steel rods. On these rods the borax crystallizes just as rock candy clings to a string. When the borax is all out of solution the rods are withdrawn from the water, and the crystals of borax scraped off. By dissolving them again and recrystallizing, a purer form of borax is secured. When powdered it is ready for the market.

Borax is used in hundreds of different ways, and, as people become more familiar with it, the demand grows greater. The great packers consume large quantities in the dry packing of meat for export, and iron and glass workers and enameling factories use it constantly as a flux.

But the greatest portion of the whole amount is consumed in the household. Not being a patented commodity it sells at its real market value, which is about 7 cents a pound. Its alkaline properties make it valuable for softening hard water, and for cleaning woodwork. Almost every housewife is familiar with it. It is also used in various ways as a medicine and in the toilet. It is also said to be death on insects of all kinds.

An artificial ivory, called lactitis, is now made of skimmed milk coagulated, mixed with borax, and submitted to tremendous pressure. This substance is used for combs, billiard balls and other articles.

THE GRAND CANYON OF ARIZONA

Travelers agree that the Grand Canyon of Arizona, formed where the Colorado river has carved a great channel for itself across the northwestern part of that territory, is the most wonderful of all scenic displays in the world. For many years this amazing chasm was unknown to white men or unvisited by them, but in more recent times trails were cut and then roads, and now a railway has been built until it may be viewed with entire comfort and ease by any one who takes the transcontinental journey by way of the railway which reaches the brink of the canyon. As access became easier and travelers began to increase in number, the beauties and grandeur of the place became better known.

To-day it is the favored destination of geologists, artists and explorers who find no other scene so worthy of their attention in all the world. Some of the most eminent literary men and graphic lecturers have journeyed thither, and their accounts, although falling far short of giving a complete idea of the wonders of the place, are the next thing to a personal journey of investigation.

By Courtesy of the Santa Fe Railway.
IN THE GRAND CANYON OF ARIZONA.
Showing the Colorado River in the inner gorge at the foot of Bright Angel Trail.

The first real exploration of the Grand Canyon was made by Major J. W. Powell in 1869, and since that time no other exploration has equaled his journey in daring or surpassed it in achievements. He has published a book of great value, descriptive of that exploration and others which he made in succeeding years. The artist George Wharton James, some years later, lived for a considerable period on the brink of the Canyon and in its depths, studying its varied moods and painting it in intimacy, with the result that he too issued a beautiful volume which serves as the best reference book and guide to the region. Other minor books have been published, including artistic and valuable guides issued by the railway company. Magazine articles have been contributed by such authors as C. F. Lummis, Harriet

Monroe, Joaquin Miller, Hamlin Garland, Charles Dudley Warner and others. Poets, too, as well as painters and photographers, have lent their art in the effort to interpret and picture the glories of the Canyon. It is a subject of never failing interest and one to which no one has yet done justice.

Few men have known the Grand Canyon of Arizona better than did C. A. Higgins, who camped in it, traveled all its trails, and studied it in every one of its changing conditions. An artist by temperament, he saw the spendid scene in all its significance, and with a graphic pen told what he saw in modest fashion. The account which follows is condensed from an article by Mr. Higgins.

"The Colorado is one of the great rivers of North America. Formed in southern Utah by the confluence of the Green and Grand, it intersects the northwestern corner of Arizona, and, becoming the eastern boundary of Nevada and California, flows southward until it reaches tidewater in the Gulf of California, Mexico. It drains a territory of 300,000 square miles, and, traced back to the rise of its principal source, is 2,000 miles long. At two points, Needles and Yuma on the California boundary, it is crossed by a railroad. Elsewhere its course lies far from Caucasian settlements and far from the routes of common travel, in the heart of a vast region fenced on the one hand by arid plains or deep forests and on the other by formidable mountains.

"The early Spanish explorers first reported it to the civilized world in 1540, two separate expeditions becoming acquainted with the river for a comparatively short distance above its mouth, and an- journeying from the Moki Pueblos northwestward across the desert, obtaining the first view of the Big Canyon, failing in every effort to descend the canyon wall, and spying the river only from afar. Again, in 1776, a Spanish priest traveling southward through Utah struck off from the Virgin River to the southeast and found a practicable crossing at a point that still bears the name 'Vade de los Padres.'

"For more than eighty years thereafter the Big Canyon remained unvisited except by the Indian, the Mormon herdsman and the trapper, although the Sitgreaves expedition of 1851, journeying westward, struck the river about 150 miles above Yuma, and Lieutenant Whipple in 1854 made a survey for a practicable railroad route along the thirty-fifth parallel, where the Santa Fe railway has since been constructed.

"The establishment of military posts in New Mexico and Utah having made desirable the use of a waterway for the cheap transportation of supplies, in 1857 the War Department dispatched an expedition in charge of Lieutenant Ives to explore the Colorado as far from its mouth as navigation should be found practicable. Ives ascended the river in a specially constructed steamboat to the head of Black Canyon, a few miles below the confluence of the Virgin River in Nevada, where further navigation became impossible; then, returning to the Needles, he set off across the country toward the northeast. He reached the Big Canyon at Diamond Creek and at Cataract Creek in the spring of 1858, and from the latter point made a wide southward detour around the San Francisco Peaks, thence northeastward to the Moki Pueblos, thence eastward to Fort Defiance, and so back to civilization.

"That is the history of the explorations of the Colorado up to forty years ago. Its exact course was unknown for many hundred miles, even its origin being a matter of conjecture. It was difficult to approach within a distance of two or three miles from the channel, while descent to the river's edge could be hazarded only at wide intervals, inasmuch as it lay in an appalling fissure at the foot of seemingly impassable cliff terraces that led down from the bordering plateau; and to attempt its navigation was to court death. It was known in a general way that the entire channel between Nevada and Utah was of the same titanic character, reaching its culmination nearly midway in its course through Arizona.

"In 1869 Major J. W. Powell undertook the exploration of the river with nine men and four boats, starting from Green River City, on the Green River, in Utah. The project met with the most urgent remonstrance from those who were best acquainted with the region, including the Indians, who maintained that boats could not possibly live in any one of a score of rapids and falls known to them, to say nothing of the vast unknown stretches in which at any moment a Niagara might be disclosed. It was also currently believed that for hundreds of miles the river disappeared wholly beneath the surface of the earth.

"Powell launched his flotilla on May 24, and on August 30 landed at the mouth of the Virgin River, more than one thousand miles by the river channel from the place of starting, minus two boats and four men. One of the men had left the expedition by way of an Indian reservation agency before reaching Arizona, and three, after holding out against unprecedented terrors for many weeks, had finally become daunted, choosing to encounter the perils of an unknown desert rather than to brave any longer the frightful menaces of that Stygian torrent. These three, unfortunately making their appearance on the plateau at a time when a recent depredation was colorably chargeable upon them, they were killed by Indians, their story of having come thus far down the river in boats being wholly discredited by their captors.

"Powell's journal of the trip is a fascinating tale, written in a compact and modest style, which, in spite of its reticence, tells an epic story of purest heroism. It definitely established the scene of his exploration as the most wonderful geological and spectacular phenomenon known to mankind, and justified the name which had been bestowed upon it—the Grand Canyon, sublimest of gorges, Titan of chasms. Many scientists have since visited it, and, in the aggregate, a large number of unprofessional lovers of nature; but until a few years ago no adequate facilities were provided for the general sight-seer, and the world's most stupendous panorama was known principally through report, by reason of the discomforts and difficulties of the trip, which deterred all except the most indefatigable enthusiasts. Even its geographical location is the subject of widespread misapprehension.

"Its title has been pirated for application to relatively insignificant canyons in distant parts of the country, and thousands of tourists have been led to believe that they saw the Grand Canyon, when, in fact, they looked upon a totally different scene, between which and the real Grand Canyon there is no more comparison 'than there is between the Alleghenies or Trosachs and the Himalayas.' There is but one Grand any considerable fragments remain, they bound onward like elastic balls, leaping in wild parabola from point to point, snapping trees like straws; bursting, crashing, thundering down the declivities, until they make a last plunge over the brink of a void; and then there comes languidly up the cliff sides a faint roar, and your boulder that had withstood the buffets of centuries lies scattered as wide as Wycliffe's ashes, although the final fragment has lodged only a little way, so to speak, below the rim. Such performances are frequently given in these amphitheaters without human aid, by the mere undermining of the rain, or perhaps it is here that Sisyphus rehearses his unending task. Often in the silence of the night some tremendous fragment has been heard crashing from terrace to terrace with shocks like thunder peal.

"The spectacle is so symmetrical, and so completely excludes the outside world and its accustomed standards, it is with difficulty one can acquire any notion of its immensity. Were it half as deep, half as broad, it would be no less bewildering, so utterly does it baffle human grasp."

Within the last few years a hotel has been built on the very verge of the canyon, and a railway has been built which connects directly with the transcontinental trains at the station of Williams, Arizona. This makes the journey available for any traveler, and since the train service to the rim of the canyon was established, visitors have multiplied rapidly. This is one of nature's marvels which can not be spoiled by the arrival of numbers or the building of hotels, so enormous is it, and with the Colorado river still roaring in its channel, continuing the mighty work of erosion, we may presume that the Grand Canyon of Arizona will remain as long as the world lasts, carving a deeper gorge, century by century, inspiring profound emotions in the beholders after generations have passed.

THE DAKOTA "BAD LANDS"

Hardly more than half a century ago, some of our greatest statesmen earnestly opposed any legislation or expenditure for the development or the exploration of the great region of the United States west of the Mississippi river. Even Daniel Webster, when the first transcontinental railway was under discussion in Congress, declared that he would never vote to appropriate one cent to connect the east with the Pacific coast, across thousands of miles of utterly worthless, uninhabitable desert country. A few government exploring parties had traversed the great west and reported on it, and accounts of various regions had come from daring pioneers and explorers who had forced their way beyond the frontier, out of sheer joy of life in the wilderness. This was virtually the extent of knowledge of what is now the prosperous and populous land of the west.

Such areas as what we know as the "Bad Lands" of Dakota, the "Terres Mauvaises" of the French voyageurs, went far to justify the bad name which was ascribed to the entire country before it was realized that these peculiar formations were but a small portion of the whole. We can well spare a little of the vast domain which our country holds between the Mississippi and the Pacific to display the varied works of nature in different humors. The mountain ranges, the canyons, the waterfalls, the glow of color on the rock walls of cliff and gorge heat. Within the crater, as without, the surface is entirely covered with volcanic rocks.

Directly north of the island is Llao Rock, a grand old sentinel, reaching to a perpendicular height above the surface of the lake of more than 2,000 feet. From the top of it you can drop a stone and it will grow smaller and smaller, until your head begins to swim and you see the stone become a mere speck and fade entirely from view; and at last, nearly half a mile below, it strikes the unruffled surface of the water and sinks forever from sight in the depths of an almost bottomless lake.

There is probably no other point of interest in America that so completely overcomes the ordinary Indian with fear as Crater Lake. From time immemorial, no power has been strong enough to induce him to approach within sight of it. For a paltry sum he will engage to guide you thither, but before you reach the mountain top will leave you to proceed alone. To the savage mind it is clothed with a deep veil of mystery, and is the abode of all manner of demons and unshapely monsters.

When the exploration of the lake was made, boats had to be built in Portland, Oregon, transported 340 miles by rail, and then carried to the lake on wagons, 100 miles into the mountains, where they were launched over sheer cliffs 1,000 feet high. Soundings were made all over the lake, and the greatest depth found was 2,008 feet, while 600 feet was the depth of the shallowest water. The shore is entirely encircled with precipitous cliffs, coming down at but one place as low as 500 feet above the water. On one side, however, it was possible to make trails to the water's edge. Grottoes, bays, islands, cliffs and many strange formations help to magnify the beauty of the scene.

In closing his account of this phenomenon, Mr. Steel says in part: "Crater Lake is but a striking memento of a dead past. Imagine a vast mountain, six by seven miles through at an elevation of 8,000 feet, with the top removed and the inside hollowed out and filled with the clearest water in the world to within 2,000 feet of the top; then place a round island in one end, 845 feet high, in which dig a circular hole tapering to the center like a funnel, 100 feet deep and 475 feet in diameter, and you have a perfect representation of Crater Lake. The surface of the water is twenty-three feet higher than the summit of Mount Washington. What an immense affair it must have been, ages upon ages ago, when, long before the hot breath of a volcano soiled its hoary head, standing as a proud monarch, with its feet upon earth and its head in the heavens, it towered far, far above the mountain ranges, aye, looked far down upon the snowy peaks of Hood and Shasta, and snuffed the air beyond the reach of Everest. Then streams of fire began to shoot forth, great seas of lava were hurled upon the earth beneath. The elements seemed bent upon establishing hell upon earth, and fixing its throne upon this great mountain. At last the foundations gave way and it sank forever from sight, down, down, down, deep into the bowels of the earth, leaving a great black, smoking chasm, which succeeding ages filled with pure, fresh water, giving to our day and generation one of the most beautiful lakes within the vision of man."

CAUSE OF EARTHQUAKES AND VOLCANOES

The great phenomena of nature in the course of ages undergo many modifications. We do not expect that there will ever again be an age of ice and glaciers, a carboniferous age, an age of gigantic animals and reptiles, nor yet a general flood over the continents. And yet some of the great forces of nature, hardly second in magnitude to these manifestations, repeat themselves at frequent intervals. Volcanoes and earthquakes, for instance, in some parts of the globe recur with great frequency, while elsewhere, though they may be virtually unknown, slight shocks are sometimes felt. It often happens that just as the world has settled to a belief that the day of great disasters is past, some vast catastrophe occurs which destroys life and property through a large area, and proves that these internal forces have been but slumbering and are not extinct. Such was the circumstance with the terrible eruptions of May 8, 1902, in the West Indies. Mount Pelee, on the island of Martinique, and La Soufriere on the island of St. Vincent suddenly burst their bounds, and almost in an instant destroyed thousands of lives and at least one beautiful and prosperous city. It has been many years since the world has seen a catastrophe equal to this, and it will be long before mankind rests again in such complacent assurance that there is no danger in living under the shadow of a sleeping volcano.

The earth, like the human body, is subject to constitutional derangements. The fires and the impurities of the blood manifest themselves in the shape of boils and eruptions upon the human body. The internal heat of the earth, and the chemical changes which are constantly taking place in the interior of the globe, manifest themselves outwardly in the form of earthquakes and volcanoes. In other words, a volcano is a boil or eruption on the earth's surface.

Scientists have advanced many theories concerning the primary causes of volcanoes, and many explanations relating to the igneous matter discharged from their craters. Like the doctors who disagree in the diagnosis of a human malady, the geologists and volcanists are equally unable to agree in all details concerning this form of the earth's ailment. After all theories relating to the cause of volcanoes have been considered, the one that is most tenable, and is sustained by the largest number of scientific men, is that which traces volcanic effects back to the old accepted cause of internal fires in the center of the earth. Only in this way can the molten streams of lava emitted by volcanoes be accounted for. The youngest student of familiar science knows that heat generates an upward and outward force, and, like all forces, it follows the path of least resistance. This force is always present in the internal region of the earth, which for ages upon ages has been gradually cooling from its poles toward the center. When conditions occur by which it can outwardly manifest itself, it follows the natural law and escapes where the crust of the earth is thinnest.

But something more than the mere presence of internal fire is necessary to account for volcanic action, although it may, in a large degree, account for minor seismic convulsions in the form of an earthquake. The elements which enter into the source of a volcanic eruption are fire and water. The characteristic phenomenon of a volcanic eruption is the steam which issues from the crater before the appearance of the molten lava, dust, ashes and scoria. This accepted theory is plainly illustrated in the eruption of a geyser, which is merely a small water volcano. The water basin of a geyser is connected by a natural bore with a region of great internal heat, and as fast as the heat turns the water into steam columns of steam and hot water are thrown up from the crater.

One form of volcanic eruption, and its simplest form, is likewise illustrated in a boiler explosion. Observations of the most violent volcanic eruptions show them to be only tremendous boiler explosions at a great depth beneath the earth's surface, where a great quantity of water has been temporarily imprisoned and suddenly converted into steam. In minor eruptions the presence of steam is not noticeable in such quantities, which is simply because the amount of imprisoned water was small and the amount of steam generated was only sufficient to expel the volcanic dust and ashes which formed beneath the

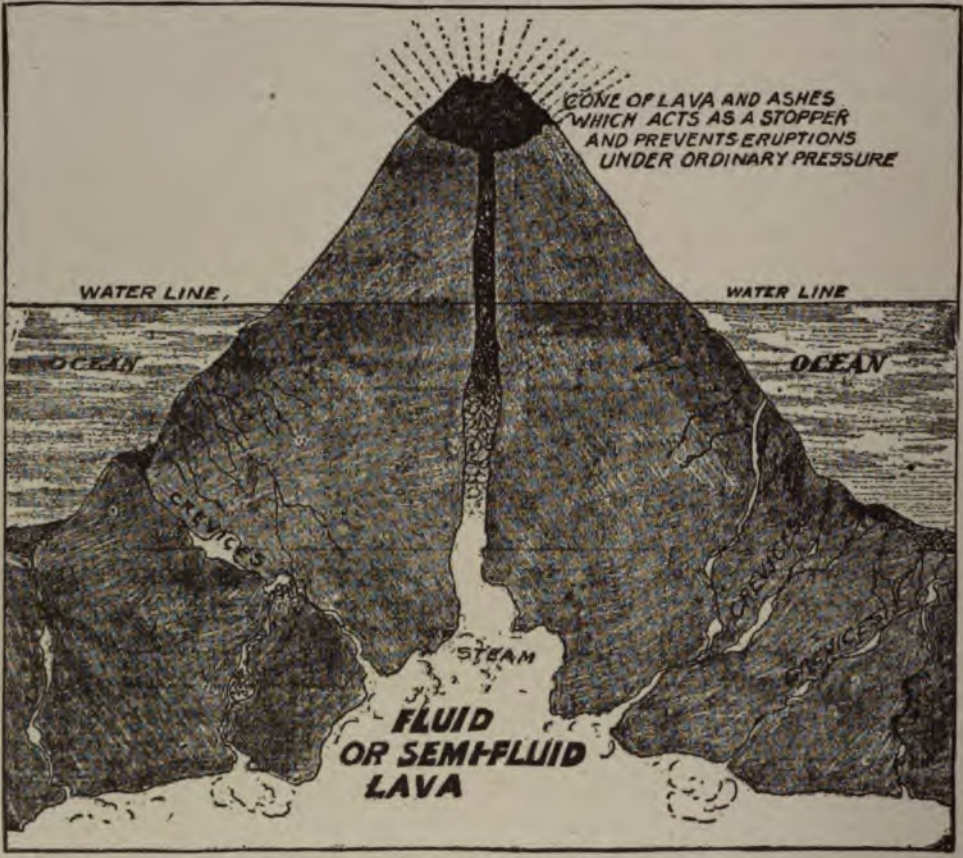


DIAGRAM SHOWING CAUSE OF A VOLCANO.
The water percolating through the crevices reaches the molten rock, when steam is generated and the pressure blows the head off the mountain.

earth's surface and the internal fires of the volcano. The flow of lava which follows violent eruptions is expelled by the outward and upward force of the great internal heat, through the opening made by the steam which precedes it.

The two lines of volcanoes, one north and one south, the other east and west, which intersect in the neighborhood of the West Indies, follow the course where the crust of the earth is thinnest, and where great bodies of water lie on shallow parts of the ocean bed. The terrific heat of the earth's internal fires is sufficient to cause crevices, leading from these bodies of water to the central fires of the volcano, and the character of the volcanic eruption is determined largely by the size of the crevices so created and the amount of water which finds its way through them. The temperature of these internal fires can only be guessed at, but some idea may be formed of their intense heat from streams of lava emitted from the volcano. These will sometimes run ten or twelve miles in the open air before cooling sufficiently to solidify. From this it will be seen that the fires are much hotter than are required merely to reduce the rock to a liquid form. From this fact, too, may be seen the instantaneous action by which the water seeping or flowing into the heart of the volcano is converted into steam and a tremendous explosive power generated.

At a depth of about thirty miles, the internal heat of the earth is probably great enough to melt all known substances. Confinement may keep in a rigid condition the material which lies beneath the solid crust, but if an avenue of escape is once opened the stuff will soften and ooze upward. There is a growing tendency, moreover, to recognize the importance of gravitation in producing eruptions. The weight of several miles of rock is almost inconceivable, and it certainly ought to compel potentially plastic matter to rise through any crevice that might be newly formed. Some authorities regard this as the chief mechanical agent in an eruption, at least when there is a considerable outpouring of lava.

As to the extent to which water operates, there is some lack of harmony among volcanists. Some point to the fact that many volcanoes are situated near the coasts of continents or on islands where leakage from the ocean may possibly occur. Others regard water as not the initial factor, but an occasional though important reinforcement. They suggest that when the molten rock has risen to a considerable distance it encounters water, and steam is then suddenly generated. The explosive effects which ensue are of two kinds. By the expansion of the moisture which some of the lava contains the latter is reduced to a state of powder and thus originate the enormous clouds of fine dust which are ejected. Shocks of greater or less violence are also produced. The less severe ones sound like the discharge of artillery and give rise to tremors in the immediate vicinity. In extreme cases enough force is developed to rend the walls of the volcano itself.

The precise manner in which the plastic inside of the terrestrial shell gets access to the surface is not entirely clear. Nevertheless it is possible to get some light on the matter. It is now well known that in many places there are deep cracks or faults in the earth's crust. Some of them in the remote past have been wide and deep enough to admit molten material from below. The Palisades of the Hudson are believed to have been formed by such an intrusion, the adjacent rock on the eastern face having since been worn away by the water or other agents. It has been observed that many volcanoes are distributed along similar faults.

The existence of a chain of volcanic islands in the West Indies suggests the probability that it follows a crack of great antiquity, though the issue of lava and ashes for several centuries may have been limited to a few isolated points. Just how these vents have been reopened is one of the most difficult questions still left for investigation. Given a line of weakness in the rocks though, and a susceptibility to fresh fracture is afforded.

There are two great circles of volcanoes about the earth. One girdles the earth north and south, extending through Tierra del Fuego (called "land of fire" because of its volcanoes), Mexico and the West Indies, the Aleutian islands and down the islands of the coast of Asia and the East Indies through Australia to the south pole. The other passes east and west through Hawaii, Mexico, the West Indies, Italy and Asia Minor. These two circles intersect at two points. One of these is in the West Indies, the scene of this recent terrible disaster, and the other is in the East Indies, where eruptions are frequent. It is just at these points of intersection of the two volcanic rings that we expect unusual volcanic activity, and it is there that we find it. All this is of interest, as showing that the earth is still in the process of formation, just as much as it was hundreds of

RUINS OF ST. PIERRE, MARTINIQUE.
Showing steamship Roraima burning in the harbor.

centuries ago. We see the same thing in Yellowstone Park. There most decided changes have taken place even in the last few years.

There has been more or less theorizing as to volcanic disturbances moving in cycles, but it cannot be proved. There is no doubt, however, that eruptions sometimes break forth simultaneously in widely distant portions of the earth. A sympathetic relation of this kind has long been known between Mount Hecla in Iceland and Mount Vesuvius in Italy, and it is very probable that the volcanoes of the West Indies have some such sympathetic relation with the volcanoes of Central America and southern Mexico, which were in eruption about the same time.

FAMOUS VOLCANIC AND EARTHQUAKE DISASTERS

The cataclysms of nature which we know as earthquakes and volcanoes are closely allied, although widely different in their effects. The terrible disasters of the past that have come down to us through the centuries, and those of more recent times, have sometimes been of one character and sometimes of another, although always incited by the same internal convulsions of the earth.

In the history of earthquakes nothing is more remarkable than the extreme fewness of those recorded before the beginning of the Christian era, in comparison with those that have been registered since that time. This may be partly accounted for by the fact that before the birth of Christ there was but a small portion of the habitable surface of the globe known to those who were capable of handing down a record of natural events. The vast increase in the number of earthquakes in recent times is, therefore, undoubtedly due to the enlargement of our knowledge of the earth's surface and to the greater freedom of communication which we now have.

Earthquakes might have been as frequent throughout the entire globe in ancient times as now, but the writers of the Bible and the historians of Greece and Rome might have known nothing of their occurrence. Even at the present time an earthquake might happen in central Africa or in central Asia of which we would never hear, and the recollection of which might die out among the natives in a few generations. In countries, too, which are thinly inhabited and where there are no large cities to be overthrown, even great earthquakes might happen almost unheeded. The few inhabitants might be awe-struck at the time, but if they sustained no personal harm, the violence of the commotion and intensity of their terror would soon fade from their memory.

Doctor Daubeny, in his work on volcanoes, cites an example of this complete oblivion even when the event must have occurred not far from the ancient center of civilization. The town of Lessa, between Rome and Naples, and not far from Gaeta, stands on an eminence composed of volcanic rocks. In digging the foundation for a house at this place some years ago, there were discovered many feet beneath the present surface the remains of an amphitheater and a chamber with antique frescoes. Yet there is not only no existing account of the destruction of a town on this site, but not even a tradition of any volcanic eruption in the neighborhood.

The earthquake which destroyed Sodom and Gomorrah is not only the oldest on record, but one of the most remarkable. It was accompanied by a volcanic eruption, it upheaved a district of several hundred square leagues, and caused the subsidence of a tract of land not less extensive, altering the whole water system and the levels of the soil. The south of Palestine contained a splendid valley, dotted with forests and flourishing cities. This was the valley of Siddim, in which reigned the confederate sovereigns of Sodom, Gomorrah, Adniah, Zeboiim and Zoar. They had joined forces to resist the king of the Elamites, and they had just lost the decisive battle of the campaign when the catastrophe which destroyed the five cities and spread desolation in the flourishing valley took place. As the sun arose the ground trembled and opened, red hot stones and burning cinders, which fell like a storm of fire upon the surrounding country, being emitted from the yawning chasm.

This was a sudden volcanic eruption like that which destroyed in one night the cities of Pompeii and Herculaneum. When, after the disaster, the inhabitants of neighboring regions came to visit the scene of it, they found the whole aspect of the district altered. The valley of Siddim had ceased to exist, and an immense sheet of water covered the space which it once occupied. Beyond this vast reservoir, to the south, the Jordan, which formerly fertilized the country as far as the Red Sea, had also disappeared. The whole country was covered with lava, ashes and salt. All the cultivated fields, the hamlets and villages had been destroyed. As it was upon the morrow of the catastrophe, so the region has remained, with its calcined rocks, its blocks of salt, its masses of black lava, its rough ravines, its sulphurous springs, its boiling waters, its bituminous marshes, its riven mountains, and its vast Lake Asphaltite, which is the Dead Sea.

The destruction of Pompeii and Herculaneum by the eruption of Mount Vesuvius on the 23d of August, A. D. 79, is the most interesting of all such disasters. We have the distinct advantage of detailed descriptions of it written by eminent historians and authors of the day, who were eye witnesses, and whose writings were preserved with care. In addition, within the last century Pompeii has been systematically excavated. The work has been slow, though continuous, and great progress has been made in disinterring the buried city. To-day it is a municipal museum of the Roman Empire as it was eighteen hundred years ago. The architecture is almost unmarred; the colors of decorated tiles on the walls are still bright; the wheel-marks in the roads are fresh looking. The picture of domestic life as it was is complete, except for the people who were destroyed or driven from the city. No other place in all the world so completely portrays that period of the past to us as does Pompeii, overwhelmed by Vesuvius, hidden for centuries, and now once more in view to the world to-day.

Mount Ætna, on the Italian island of Sicily, has been active for at least twenty-five centuries, with a historical record of seventy-eight distinct eruptions. Some of these have been disastrous in their destruction of life and property, and many thousands of persons have been killed as a result of these eruptions.

Lisbon, the beautiful capital of Portugal, on the Tagus River, has been devastated by earthquakes and tidal waves more than once. The greatest of these was the appalling disaster of 1755, when in a few moments 60,000 lives were lost, either by the destruction of the city itself, in the falling buildings, or by drowning in the tidal wave that swept over the shattered metropolis. The portion of the earth's surface convulsed by this earthquake is estimated to have been four times greater than the whole extent of Europe. The earthquake was felt in the West Indies, Canada, Scotland, Sweden, Germany and Morocco.

India, Turkey, Persia and Japan have been the scene of numerous destructive earthquakes and volcanic eruptions. Some of these have destroyed prosperous cities and thousands of lives. The last great earthquake in Japan was in 1891, when 40,000 houses were thrown down and about 24,000 persons were killed and wounded. Owing to the frequency of earthquake shocks in Japan, the study of their causes and effects has had a great deal of attention there since the introduction of modern science into the island empire. The Japanese have proved as energetic in this direction as they are in purely material progress on lines of western civilization, and already they are recognized as the most advanced of all people in the

RUINS OF OZAKI, JAPAN, AFTER THE GREAT EARTHQUAKE.

world in their study of the phenomena of earthquakes and volcanoes.

The greatest single volcanic explosion recorded in the history of the world occurred in 1883, beginning on the afternoon of Sunday, August 26, on the island of Krakatoa, in the Malay archipelago of the East Indies. Krakatoa is one of a group of volcanic islands in Sunda strait, between Sumatra and Java. The volcanic cone of this island had been agitated for some months prior to the date of the greatest eruption, and when, finally, nature's forces exploded themselves without restraint, all records had been broken. The entire series of grand phenomena extended over a little more than thirty-six hours. From sunset on Sunday till midnight the tremendous detonations followed each other so quickly that a continuous roar may be said to have issued from the island. The distance of ninety-six miles from Krakatoa was not sufficient to permit sleep to the inhabitants of Batavia. All night volcanic thunders sounded like the discharge of artillery at their very doors.

On the next morning there were four mighty explosions. The third one was of appalling violence and it gave rise to the most far reaching effects. The cloud of smoke, vapor and dust in the air was blown up to a height of seventeen miles into space. The volcanic ash which fell upon the neighboring islands within a circle of nine and a half miles radius was sixty-five to 130 feet thick. Masses of floating pumice encumbered the strait, and the coarser particles of this ash fell over a known area equal to the whole of the New England States, New York, New Jersey, Pennsylvania, Ohio, Indiana and Illinois. It is calculated that the matter so ejected must have been considerably over a cubic mile in volume. The sound itself of this horrible explosion was heard by trustworthy witnesses at various places to a distance of nearly 3,000 miles and the atmospheric wave caused by the mighty outburst passed seven times around the world and left its record on the instruments in various observatories before it finally subsided.

At least 36,000 lives were lost. The island itself was completely changed. The whole northern and lower portion of it vanished except an isolated rock ten yards square and projecting out of the ocean with deep water all around it. What a tremendous work this must have been is attested by the fact that where Krakatoa island, girt with luxuriant forests, once towered from 300 to 1,400 feet above the sunlit waters, it is now in some places more than 1,000 feet below them. Krakatoa has gained undying fame as the island that blew its own head off.

Under the American flag we are ourselves the possessors of some of the greatest active volcanoes in the world, and the greatest of all craters, the latter extinct, indeed, for many years, but with a latent power that no one could conceive should it once more be in activity. Hawaii, "Paradise of the Pacific," raised by the fires of inner earth out of the depths of the ocean centuries ago, has become in recent years a smiling land of tropic beauty, and an American island possession. It is a land of great volcanoes, sometimes slumbering and again pouring forth floods of molten fire to overwhelm the peaceful villages and arouse the superstitious fears of the natives. Alaska, too, is a region of great eruptive activity, the Aleutian islands being raised from the bed of the Pacific by the same natural forces.

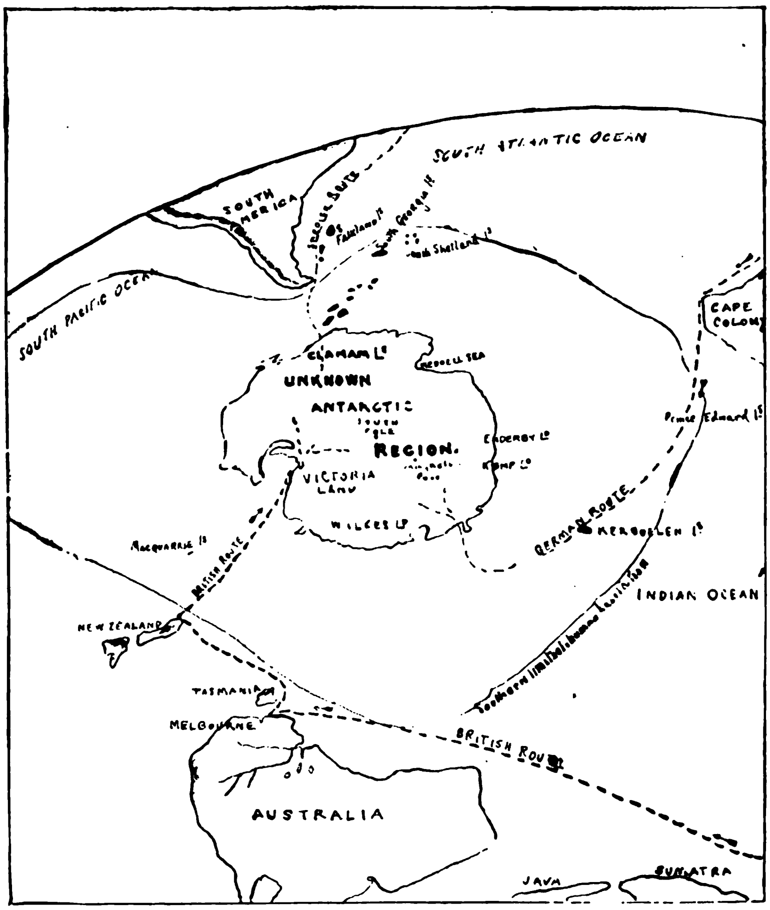
The cities of Peru, Chile and the other South American republics have frequently suffered earthquake shocks and tidal waves. Lima, Callao and Caracas have been devastated at different times. The Isthmus of Panama, the Central American republics and Mexico have likewise suffered. The great mountain range which connects our own Rocky Mountains with the Andes by way of Mexico and Central America, is largely volcanic in its character, and eruptions of greater or less violence are not uncommon. Farther north in the United States the Rocky mountains and the Sierras have many volcanic peaks, happily extinct for many years. Even Mount Hood and Mount Ranier, near the cities of Portland, Oregon, and Tacoma, Washington, are well recognized as volcanic, and, indeed, they emit smoke and sulphurous vapor at all times, though there has been no eruption within the memory of man. If they should awaken, the danger to the populous cities of the northwest would be great.

Most recent of all great volcanic eruptions was that of May, 1902, in the Caribbean Sea, when the islands of Martinique and St. Vincent were devastated and many thousands of lives were lost. The scenes of that terrible catastrophe, in which the city of St. Pierre was overwhelmed and hardly one person escaped alive, have been graphically recorded by the descriptive and scientific investigators who hastened to the place, and by those who, upon ships in the harbors or in other places of partial safety, were eye witnesses. It would be a happy condition if we could be assured that never again would such a blighting disaster befall any community. But the irresistible forces of nature, although dormant, are never extinct, and it is impossible to promise immunity.

AROUND THE SOUTH POLE

For centuries adventurous navigators have sought to explore the far north in the effort to discover the North Pole, and learn the conditions surrounding the polar regions. The South Pole has not attracted as much attention for various manifest reasons. The populated continents of Europe, Asia, and North America surround the North Pole, and offer means of comparatively close approach to it, so that the explorations can be made for a great distance by land, with some hope of escape in the event of disaster. There was a commercial reason, too, why the far north should be explored in the effort to find a track for vessels desiring to pass from the Atlantic to the Pacific, either by a northwestern or a northeastern course, which would be many thousands of miles shorter than the great detour by way of Cape Horn or the Cape of Good Hope. In the far north, too, man, animals and some vegetation served to make explorations easier. The Lapp and the Eskimo, the fox and the deer, the bear and the muskox, were almost always to be found for assistance or for food. It is said that man has never yet gone northward so far as not to find vegetation of some kind, the humble flower, the hardy grass, the resolute lichen. Explorers have gone within 400 miles of the North Pole or beyond eighty-four degrees north latitude.

The South Pole and Antarctic regions present a striking contrast, being surrounded by great oceans, with South Africa, South America, Tasmania and New Zealand, the nearest inhabited lands, long distances away. No plant life has been found south of sixty-four degrees south latitude, and the snow line descends to the water's edge in every land within the Antarctic circle. No quadruped has been



BIRD'S-EYE VIEW OF THE SOUTH POLAR REGIONS.
Showing the southernmost inhabited lands, and the routes of recent exploring expeditions.

found south of sixty degrees south latitude, so that there is a belt outside of the Antarctic circle almost as wide as that within, which does not sustain animal life. The isolated islands discovered within the Antarctic regions are almost everywhere inaccessible. The advance of explorers has been stopped by ice barriers in every direction, from 300 miles to 500 miles more distant from the Pole than has been attained in the Arctic regions. Icebergs from the Arctic ocean are carried as far south as the fortieth parallel, but bergs and floes in the Antarctic are found even in the summer ten or fifteen degrees nearer the equator. The Antarctic region as compared with the Arctic is remarkable for low temperatures. South of the sixty-second parallel the mean temperature of the sea and air is always below the freezing point of fresh water.

Few navigators have crossed the Antarctic circle, and fewer still have passed the seventieth parallel. Within the last few years, however, there has been a revival of interest in Antarctic exploration, and four distinct voyages have been made in the effort to penetrate the mysteries of that dreary sea of ice. One of these was under British auspices, one was Swedish, and one was German. The course of these three is indicated on the accompanying sketch map, which gives a graphic idea of the world as it would look if we could see it from below. The other expedition, which was conducted by Belgian explorers, was the first in the point of time of all these recent voyages and is not indicated on the map herewith.

The famous predecessors of these most recent explorers were Captain Cook in 1772, Weddell in 1823, and Ross in 1841. The latter sighted a land with mountain ranges extending to a height of 15,000 feet, and traced the coast for 800 miles, naming it Victoria Land. He also discovered a great active volcano, 12,000 feet high and named it Mount Erebus. The islands which are named here in the far south are the South Shetlands, South Georgia, Victoria Land, Kerguelen island, Possession island, Alexander island and a few others even more obscure. The dangers of disaster in these explorations are great, and the hope of rescue in the event of calamity almost nothing. The rewards of possible success in the Antarctic do not promise to be as great as those in the event of success in the far north. The Antarctic is an uninhabited, ice-bound, perpetually frozen region, with nothing but the Aurora Australis and the active volcanoes to break the monotony, and no commercial reason to justify the loss of life and ships in the effort to win success.

MINES OF ICE IN ARIZONA

Nowhere in the world does there exist an industry more unique than that put in operation in 1902 in northern Arizona, where elaborate plans were laid to utilize the product of the ice caves in existence there. Strange it seems, too, that in this land of great heat, where in some places ice is a priceless luxury, made so by excessive freight rates which prevail in the territories, man's ingenuity has not before conceived the idea of the wholesale appropriation of the relief which nature has provided.

Not until very recently has any attempt been made to take away the apparently inexhaustible quantities of ice which have been found in the caves near Flagstaff. Now, however, it is intended to literally mine or quarry the ice, and the promoters of the scheme declare it will prove a great profit producer from the very outset, as they expect to secure ice enough not only to supply the scores of smaller stations, towns and lumber camps in that vicinity, but to provide a supply for the railroads of northern Arizona and New Mexico, even into California, as in the vast region of what was once the northern part of the great American desert ice factories have not as yet become common. Indeed, the factories at Los Angeles, Phoenix, Albuquerque and Las Vegas have for years supplied most of that district with ice, although at prices that necessarily were prohibitive, made so by the long railway haul.

The main or best known ice cave lies at the head of Clark's Valley, seventeen miles southwest of Flagstaff. Although others may be larger, they are not so accessible. A wagon road leads nearly to the cave. The people of the country think the cave was originally what is termed a "blow-out"—that is, a volcano vent made by water or gas, during some convulsion of nature, in the early history of our planet. There are many of these "blow-outs" of various size and extent scattered over Arizona.

Until August, 1901, the main cave had only been penetrated to a depth of 200 feet, and even that distance could be reached only by the possessors of small bodies. At that time E. R. Dulton, a young man

GREAT CAVES OF THE WORLD

It will be long before the wonders of nature are all revealed to man, for in addition to those which tempt travelers to remote and almost inaccessible parts of the world, there are others continually being discovered beneath the surface of the earth. Caverns have always had a mysterious interest wherever discovered. Their darkness, the unknown depths to which they may lead, the dangers of exploration in them, all appeal strongly to the seeker after the marvelous. They are almost always the result of the action of water. Those upon the seashore are hollowed out by the action of the waves, either by means of the constant battering of the surf, or the solving of some of the elements in the rock. Those which are found inland, among the mountain ranges or elsewhere, come in like fashion from the percolation of water from the rocks above, and the gradual chemical processes that take place.

BLUE GROTTO OF CAPRI, ITALY.

The most famous cavern of the former class is the Blue Grotto of Capri. This is found in the island of Capri in the Mediterranean Sea, not far from Naples. It can be reached only when the water is comparatively calm, by small boats which follow around the rocky coast and pass directly into the grotto under an arch which spans the channel. Once within, a succession of vaulted arches forms the roof of the grotto, which extends for a considerable distance into the island. Of course the sea within is calm, except when storms outside send their waves through the arched entrance and make the passage impossible. The rocks which form the roof are of a peculiarly beautiful blue in color and covered with glittering crystals. The light which passes through the entrance and reflects from the surface of the water seems to be multiplied many times, and gives the grotto a striking beauty. When artificial lights are used at night or to heighten the effect by day, the color effects are magnificent and the fame of the grotto is well justified.

The largest cavern commonly visited and conveniently open to tourists, if not the largest in the world, is Mammoth Cave in Kentucky. Two-hundred miles of avenues, passages and vaulted chambers are opened to visitors and it is well known that the cave is by no means fully explored. From a descriptive sketch by Dr. R. Ellsworth Call, a careful student of the Mammoth Cave and its conditions, the following facts of interest have been selected:

Mammoth Cave owes its discovery to an accident, so the story goes, which happened in the year 1809. It is the old story of a hunter and a bear, the pursuer and the pursued. The bear was wounded and sought its lair in a vain endeavor to escape. Hutchins, for such was the hunter's name, lost no time in acquainting others with this important discovery, and Mammoth Cave became both a fact of history and science. It is strange to relate that its first exploitation was connected with simply mercenary motives and that saltpeter intended for use in gunpowder, and connected with the War of 1812, was the incentive that led to more complete examination. The men who mined the salt soil, rich in niter, are the men who first gave to the outside world any reliable information of the great extent of this now famous world's wonder.

Within the cavern the changes which have occurred since the days of saltpeter are few. There is only that change which comes from wider acquaintance with the windings of the chambers into those that are new and formerly unknown, a change which makes the visitor despair of ever fully unraveling all the passages and crevices along which he journeys or through which he crawls. Bridges over rivers and stairs leading up impassable cliffs, the iron guards along places of danger, alone tell the visitor of the work of man.

It is impossible to mention all the objects of interest to visitors in this most gigantic cavern. The Fairy Grotto, the Gothic Avenue, Martha's Vineyard, Crystal Avenue, Echo River, Gorin's Dome, the Giant's Coffin, the Corkscrew, the Standing Rocks, the Rotunda, Audubon's Avenue, Spark's Bower, Lover's Leap, the Ruins of Karnak, Shelby's Dome, and a multitude of other special sights are shown to every visitor.

The Echo River is one of the most remarkable features in this most remarkable group of wonders. Only a small portion of its whole course is accessible to visitors, but this part is truly wonderful. At times the river flows with almost imperceptible current, while at other times it fills quite to the top the great River Hall, blotting out the Dead Sea and the River Styx, both of which are really parts of the underground stream. It is traversed by boats for a distance of half a mile, and the ride over its clear waters is one of the unique experiences of the world. Nowhere else can it be duplicated. The voyager passes under a low arch for a short space, and then the roof rises rapidly away from the water and he enters upon his subterranean water journey in real fact. Nearly all the river is one vast resonator. Its branching avenues and side crevices, its lofty roof of limestone rock, its ancient battlemented shores, all serve as reflectors of every sound, no matter how slight, and send it back intensified a thousand times, with its roughness blended into one sweet volume of glorious harmony.

Perhaps visitors to Mammoth Cave are most impressed with the lofty domes and deep pits which are found in some portions of this underground domain. Of those that are accessible to the visitor without great danger and fatigue, the best known

THE BOTTOMLESS PIT, MAMMOTH CAVE.

are Gorin's Dome, the Bottomless Pit, Mammoth Dome, Napoleon's Dome, the Maelstrom and Scylla and Charybdis, all but two of which are situated in that intricate and wonderful portion called the Labyrinth. The first named is viewed through a natural circular opening in the wall, quite three-fourths of the way from the bottom. Illuminated by the guide from a point still above that at which the visitor is situated, the effect through the brilliant lights on the walls beyond, white as alabaster, folded in a thousand curious and fantastic forms, is indescribably grand and impressive. Coupled with the great size of the space, everywhere shading off into infinite gloom, is the roar of falling water or the splash of Lilliputian cascades if seen in the dry season. Below, but beyond observation, is a portion of Echo River into which from a station high above it is possible to throw stones, the fall of which awakens ten thousand sounds and echoes. Stalactite matter of purest white, lends a variety to the vertical walls. Not far away is the Bottomless Pit, and above it, rising sheer to the topmost level of the cavern, is Shelby's Dome. Its bottom, for notwithstanding its name it has one, is nearly two hundred feet below the level at which the observer stands.

Of all the pits which the visitor sees, that called Mammoth Dome is the largest and most impressive. From the top to the bottom the distance is nearly 280 feet, while at the end the Ruins of Karnak stand out in bold relief. These giant columns closely resemble the works of art o some long lost underground race.

Far from the Mammoth Cave of Ke tucky, in the Black Hills of South Dako is another great cavern called the Wi Cave, which was discovered in 1877. Th thousand rooms have been discovered in varying in size from an ord[illegible] bedr to more than three acres, dred miles of passages h without finding the end. Out of fourteen different routes, three have been opened to the public. Its geological formation is a puzzle to the student, as the formations have no parallel in other well-known caves, and seem to upset many well-established theories. Another mystery is the fact that at times the wind blows into the cave at the mouth and at other times blows out, but when blowing a gale it is felt only at the entrance.

Other caverns, large and small, have been discovered in the United States, including some of great interest in Colorado, and others in New Mexico. This country is not unique in such works of nature, but we seem to have by far the largest and most beautiful of all, and Mammoth Cave is by all means the most famous and the most commonly visited.

THE LAND OF THE MIDNIGHT SUN

The entire Arctic and Antarctic regions may be properly called the "Land of the Midnight Sun," for at the poles darkness rules for six months in the year, and just within the Arctic and Antarctic circles the sun may actually be seen at midnight. In practice, however, the north coast of Norway has become known by this phrase, for it is the most accessible place where the striking and picturesque phenomenon of sunshine at midnight can be seen. To reach the polar region elsewhere means a genuine Arctic voyage, attractive enough for the explorer, but quite out of the question for the casual tourist. To see the midnight sun off the coast of Norway, however, it is necessary only to buy a ticket and board one of the fine vessels, built like great yachts, which make a voyage to the North Cape and beyond every summer, from various European ports. The entire coast of Norway, skirted during these voyages, is characterized by bold and beautiful scenery, with great cliffs, deep inlets or fjords, and mammoth glaciers. Waterfalls tumble from the heights above, and the life of the people in the little Norwegian villages is no less picturesque than the natural beauties of the region.

Hammerfest, the most northern town of Europe, is the metropolis of the Arctic regions, and the port from which many polar exploring expeditions have taken their departure from civilization. During the two summer months, the sun remains continually above the horizon and the climate becomes very warm. Even in the winter, when darkness rules for two months, tho weather is mild enough to permit the fisheries to be carried on as usual.

Then comes the North Cape, the extremest point in Europe, looking out over the Arctic Ocean. It is a dark, gray, slate rock, furrowed with deep clefts, rising nearly 1,000 feet abruptly from the sea. The traveler lands on the east side of the Cape, where a path has been constructed over the green, mossy slope to the top. Here the hour of midnight is awaited, when the northern sun, creeping along the horizon, and the immeasurable ocean in apparent contact with the skies, form the grand outlines in the sublime picture presented. With the North Cape ends the island belt, and the coast is washed directly by the sweeping waves of the Arctic Ocean. Beyond is the region of mystery, which is gradually being penetrated year after year, a few miles at a time, by those

NIAGARA FALLS

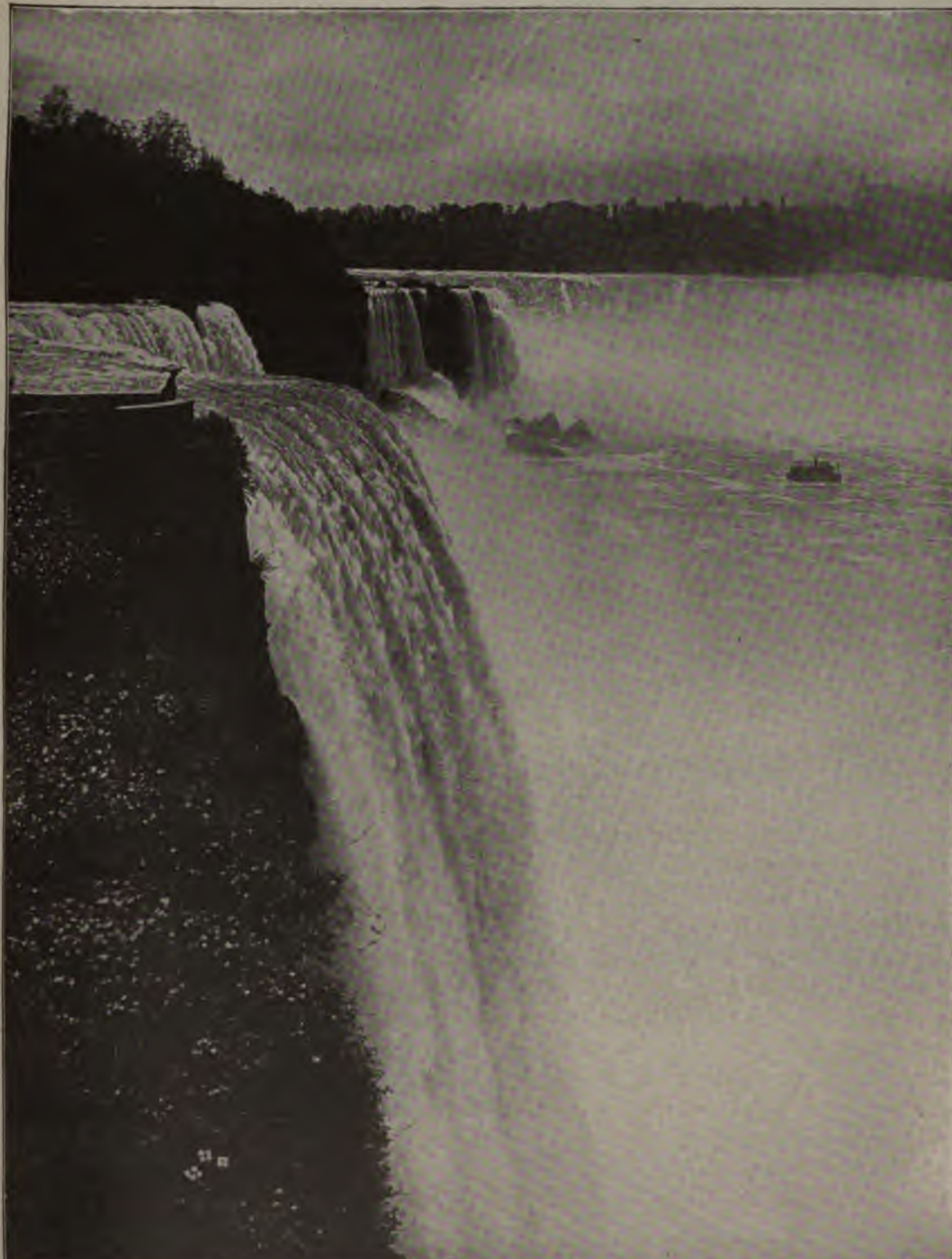
The tremendous cataract of Niagara Falls, with the wonderful rapids above and below, has been recognized for centuries as one of the greatest natural wonders of the world. From the time of the first discovery by Europeans until to-day, Niagara has been sought by travelers who thought themselves well repaid for a journey of any length when they stood for their first view of the Falls, upon the verge of the precipices that look upon it.

The earliest account which we have of the Falls was written by the missionary priest, Father Louis Hennepin, and printed in his "New Discovery" in 1697. It would be difficult to find a more picturesque traveler's tale than the good priest told as it is quoted herewith, and he may be pardoned his extravagances when we remember that he had never seen anything of the sort before.

"Betwixt the lakes of Ontario and Erie, there is a vast and prodigious cadence of water, which falls down after a surprising and astounding manner; insomuch that the universe does not afford its parallel. 'Tis true, Italy and Suedland boast of some such things, but we may well say they are but sorry patterns when compared with this of which we now speak. At the foot of this horrible precipice we meet with the river Niagara, which is not above a quarter of a league broad, but is wonderfully deep in some places. It is so rapid above this descent that it violently hurries down the wild beasts while endeavoring to pass it to feed on the other side, they not being able to withstand the force of its current, which inevitably casts them headlong, above six hundred feet high. This wonderful downfall is compounded of two great cross streams of water and two falls, with an isle sloping along the middle of it. The waters which fall from this horrible precipice do foam and boil after the most hideous manner imaginable, making an outrageous noise, more terrible than that of thunder, for when the wind blows out of the south, their dismal roaring may be heard more than fifteen leagues off."

Since Father Hennepin's time, multitudes of poets, artists and prose writers have painted with word or brush the glories of Niagara, and millions have visited it. In the space here at command, it would be a fruitless effort to attempt a description which would be satisfactory either to writer or reader. This American wonder, so stupendous, so beautiful and so accessible, should be visited by all. The curve of the gigantic Horseshoe, the green wooded islands, the ponderous curtain of the American Fall, the gorges, the rapids, the whirlpool and the surroundings offer inexhaustible scenes of marvelous beauty and of great variety.

The wide-traveled, judicial-minded and discriminating Anthony Trollope penned the deliberate opinion: "Of all the sights on this earth of ours which tourists travel to see, I am inclined to give the palm to the Falls of Niagara. In the catalogue of such sights, I intend to include all beauties of nature prepared by the Creator for the delight of His creatures. I know of no other one thing so beautiful, so glorious, and so powerful. At Niagara there is that fall of waters alone. But that fall is more graceful than Giotto's Tower, more noble than the Apollo. The peaks of the Alps are not so astounding in their solitude. The valleys of the Blue Mountains in Jamaica



(By courtesy of the Michigan Central Railroad.)

NIAGARA FALLS, THE WORLD-FAMED CATARACT.

Showing the American Fall, Goat Island and the Horseshoe Fall from Prospect Point less green. The finished glaze of life in Paris is less invariable, and the full tide of trade round the Bank of England is not so inexorably powerful."

WONDERS OF THE DEEP SEA

The time may come when there will be no portion of the earth's surface that has not been surveyed and explored by man. The work of enterprising travelers has now been carried on within a measurable distance of the North Pole; the highest mountain ranges are gradually succumbing to the geological surveyor; the heart of Africa is giving up to us its secrets and its treasures, and all the desert places of the earth are being visited. The bottom of the deep sea was until quite recently one of these unknown lands. It was regarded by most persons as one of those regions about which we do not know anything, and never shall know anything, and do not want to know anything.

But the men of science fifty years ago were not disposed to take this view of the matter. Pushing their inquiries as to the character of the sea fauna into deeper and deeper water, they at length demanded information as to the existence of forms of life in the greatest depths. Since that time, by the aid of various government appropriations and scientific expeditions, a large amount of information has been placed at our command about this most interesting region.

Hardly more than fifty years ago, the methods of deep sea investigation were so imperfect that naturalists believed life to be practically non-existent in the abysses of the great ocean. Various navigators and scientists, prior to that time, had recorded isolated discoveries of strange creatures, brought up from the depths of the sea on their sounding lines, but the facts were not scientifically classified, nor do they contribute much to the knowledge of ocean depths. Americans were pioneers in these investigations, and in 1853 two officers of the American Coast Survey made one of the most important discoveries of an inhabited region at the bottom of the sea. In 1860 the doctor on board a British man-of-war collected thirteen star-fish from a depth of 1,260 fathoms. The Norwegians and the Swedes, likewise, became active about the same time.

The physical conditions of the abyss of the great oceans are such that it is not surprising that the naturalists of the early part of the last century could not believe in the existence of life at the bottom of the deep sea. The extraordinary conditions of such a region, the enormous pressure, the absolute darkness, the probable absence of any vegetable life from want of direct sunlight, might very well have been considered sufficient to form an impassable barrier to animals migrating from the shallow waters, and to prevent the development of a fauna, peculiarly its own. The peculiar physical conditions of the deep sea may be briefly stated to be these: It is absolutely dark, so far as actual sunlight is concerned; the temperature is only a few degrees above the freezing point; the pressure is enormous; there is little or no movement of the water; the bottom is composed of a uniform fine, soft mud, and there is no plant life.

At a depth of 2,500 fathoms, the pressure is, roughly speaking, two and one-half tons per square inch, that is to say, several times greater than the pressure exerted by the steam upon the piston of our most powerful engine, or, to put the matter in other words, the pressure per square inch upon the body of every animal that lives at the bottom of the Atlantic ocean is about twenty-five times greater than the pressure that will drive a railway train.

It is but reasonable to suppose that the ability to sustain this enormous pressure can be acquired by animals only after generations of gradual migrations from the silent shallow water. Those forms that are brought up by the dredges are usually killed and distorted by the enormous and rapid diminution of pressure in their journey to the surface and it is probable that shallow water forms would be similarly killed and crushed out of shape were they suddenly plunged into very deep water. The fish that live at these enormous depths are in consequence of the enormous pressure liable to a curious form of accident. If in chasing their prey or for any other reason they rise to a considerable distance above the floor of the ocean, the gases of their swimming bladder become considerably expanded and their specific gravity very greatly reduced. Up to a certain limit the muscles of their bodies can counteract the tendency to float upwards, and enable the fish to regain its proper sphere of life at the bottom. But beyond that limit the muscles are not strong enough to drive the body downward and the fish becoming more and more buoyant as it goes, is gradually killed on its long and involuntary

STOMIAS BOA. HALF NATURAL SIZE. FROM A DEPTH OF A MILE AND A QUARTER.

journey to the surface of the sea. The deep sea fish then are exposed to a danger to which no other animals in this world are subject, namely, that of tumbling upwards.

The most recent experiments that have been made tend to show that no sunlight whatever penetrates to a greater depth than half a mile. But although it is highly probable that not a glimmer of sunlight ever penetrates to the depths of the ocean, there is in some places a very considerable illumination, due to the phosphorescence of the inhabitants of the deep water.

The floor of the ocean, if it were laid bare, would probably present a vast, undulating plain of fine mud. Not a rock, not even a stone, would be visible for miles. e mud varies in different parts of the globe according to the depth and the proximity of land and the presence of the neighboring volcanoes or the mouths of great rivers.

It has not been determined yet with any degree of accuracy where we are to place the limit of vegetable life, but it seems probable that below a hundred fathoms no organisms excepting a few parasites are to be found that can be included in the vegetable kingdom. All plants except a few are dependent upon the influence of direct sunlight and since sunlight cannot penetrate more than a few hundred fathoms of sea water, it is impossible for the plants to live below that depth. The absence of vegetable life is an important point, for it is in consequence necessary to bear in mind

COLLOSENDEIS ARCUATUS, FROM A DEPTH OF ONE MILE.

that the food of deep sea animals must be derived from the surface. It is possible that the creatures of the deep sea in some cases feed upon one another, but the fauna would soon become exhausted if it had no other sources of food supply. This other source of supply is derived from the bodies of organisms that fall from the upper waters of the ocean.

Now let us note briefly a few points of interest about the creatures themselves that have been found. The different oceans and different depths, roughly speaking, show distinct characteristics in the life found therein, as truly as do the different continents of the world. So the scientists have marked out the different zones and localities on it. Strangely enough the creatures of the deep sea vary in color to a very remarkable extent. Shades of red occur rather more frequently than they do in the fauna of any other zone or region and there are no blue animals known to live in deep water, while green, also, is extremely rare in the greatest depths. The eyes of the animals that live in deep sea water undergo curious modifications. In the majority of cases, we find that the eyes are either very large or very small. In depths of 300 to 600 fathoms the majority are large eyed forms. This is as we should expect, for it is more than probable that many of these forms occasionally wander into the shallower waters where there is a certain amount of sunlight. In depths of over one mile, the small eyed and blind forms are in the majority, although many large eyed forms are to be found.

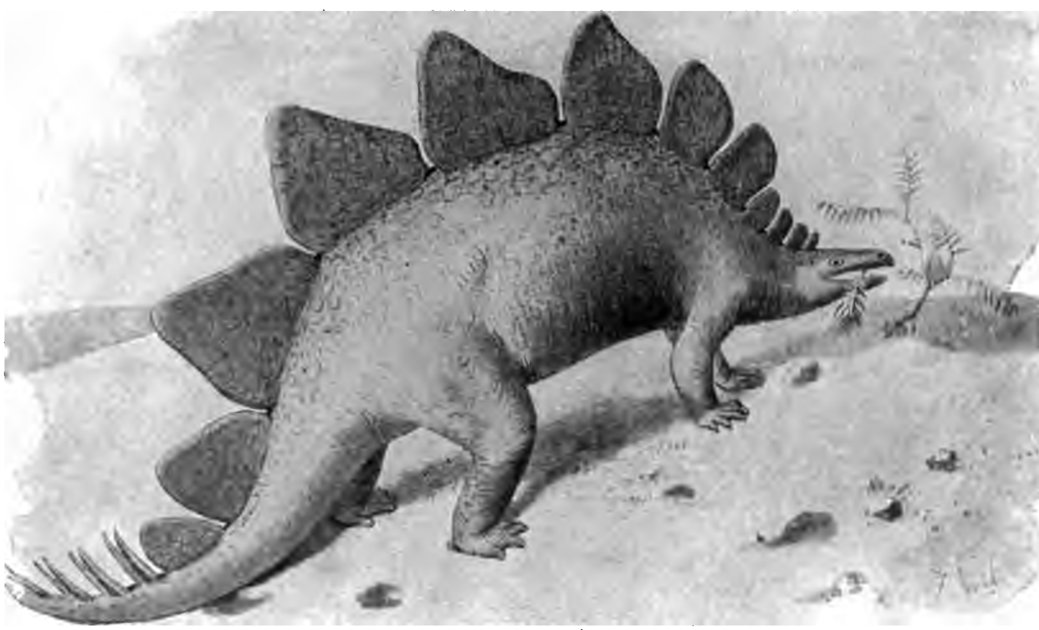
In these abysmal depths are found representatives of all the great classes of marine life which are recognized, from the true fish, which are of the highest order, through crustaceans, mollusks and seaworms to the lowest forms of protozoa, coelentera and echinoderma. The species are not large in comparison with those known to us in shallower depths, but range in size from minute forms to some which measure eight or ten inches in length. It may be a little puzzling to understand exactly what profit can come from costly investigations of these abysmal depths, and the answer must be found in the broad generalization that all knowledge is valuable, and the more we know about this world of ours the better No land has yet been found where life does not exist, and the most profound depths of the sea, miles below the surface, are likewise found to be teeming with life. Nature's wonders are everywhere, and the true scientist desires to learn of the most obscure and the most remote things as truly as of those which are near and obvious.

EXTINCT MONSTERS

Menageries and zoölogical gardens have given to every one a pretty fair idea of the characteristics of animal life to-day. These are supplemented by a wealth of fine pictures which make the rarest creatures familiar enough in appearance. But there were wonderful creatures here in this earth before man was created, and but few of them are known by name or appearance. to the average reader of to-day. And yet the actual appearance and habits of life of these extinct monsters which lived thousands of years ago can be conceived with some accuracy, thanks to the studies of learned men who have searched deep in the science of comparative anatomy. Various technical works exist upon this subject, and at least one popular account of the forms of ancient animal life. From the latter, by the Rev. H. N. Hutchinson, the following interesting facts are summarized.

Let us remember that it is not mere imagination that guides the man of science in such matters, for all his conclusions are intended to be based on reason. For millions of years countless multitudes of living animals have played their little parts on the earth and passed away, to be buried in the oozy beds of the seas of old times or entombed with the leaves that sank in the waters of primeval lakes. The majority of these perished beyond all recovery, leaving not a trace behind. Yet a vast number of fossilized remains have been in various ways preserved, sometimes almost as completely as if Dame Nature had thoughtfully embalmed them for our instruction and delight.

Down in those old seas and lakes she kept her great museum in order to preserve for us a selection of her treasures. In the course of time she slowly raised up sea beds and lake bottoms to make them into dried land. This museum is everywhere around us. We have but to enter stone quarries and railway cuttings, or to search in coal mines or under cliffs at the seaside, and we can consult her records.



A GIGANTIC ARMORED DINOSAUR. LENGTH, ABOUT THIRTY FEET.

It is to Cuvier that the world owes the first systematic application of the science of comparative anatomy and palæontology, as the science is called which treats of the living beings, animal, or vegetable, which have inhabited this globe at past periods in its history. He paid great attention to the relative shapes of animals, and the different developments of the same kind of bones in the various animals and especially to the nature of their teeth. So great did his experience and knowledge become that he rarely failed in the naming of an animal from a part of its skeleton. He appreciated more clearly than others before him the mutual dependence of the different parts of an animal's organization. "The organism," he said, "forms a connected unity in which the single parts cannot change without modifications in the other parts."

As he progressed in these studies, Cuvier was able with considerable success to restore extinct animals from their fossilized remains, to discover their habits and manner of life, and to point out their nearest living allies. To him we owe the first complete demonstration of the possibility of restoring an extinct animal. His "law of correlations," however, has been found to be not infallible, but like other laws having its exceptions. To take one out of many examples of this law: carnivorous animals, such as cats, lions and tigers, have claws in their feet, very different from the hoofs of an ox, which is herbivorous, while the teeth of the former group are very different from those of the latter. Thus the teeth and limbs have a certain definite relation to each other, or in other words are correlated. Again, horned quadrupeds are all graminivorous (grain-eating) and have hoofs to their feet. The following anecdote serves to illustrate Cuvier's law. One of his students thought he would try to frighten the master, and having dressed up as a wild beast, entered Cuvier's bedroom by night and presenting himself by his bedside, said, in hollow tones: "Cuvier, Cuvier, I have come to eat you." The great naturalist, who, on waking up was able to discern something with horns and hoofs, simply remarked: "What! Horns —Hoofs! Graminivorous. You can't."

It is impossible to describe in detail all of the greater extinct monsters which inhabited the earth, the ocean or the air, and thousands of smaller creatures are well-known and identified in museums which cannot even be suggested here. All we can do is to speak briefly of a few of the most interesting or peculiar. For instance, on the coast of Great Britain there lived sea scorpions, possessing a coat of armor, jointed bodies and limbs for crawling, swimming or seizing their prey. They were distant cousins of the crustaceans of the present day, lobsters, crabs and shrimps, but they measured at least six feet in length.

In the same waters, and about the same time, dwelt the old fish lizard or ichthyosaurus. Cuvier, describing it, said of this creature that it possessed the snout of a dolphin, the teeth of a crocodile, the head and breast bone of a lizard, the paddles of a whale or dolphin, and the vertebræ of a fish. It was a powerful monster, swimming rapidly enough to catch the fish upon which it lived. The long and pointed jaws were a striking feature of these animals, and their eyes were very powerful and large. The largest entire skeleton preserved in a museum measures twenty-two feet long, and eight feet across the expanded paddles, but from detached heads and parts of skeletons it is probable that some of them were between thirty and forty feet long. Then there were long necked sea-lizards known as the plesiosaurus, which, to the head of a lizard united the teeth of a crocodile, a neck of enormous length, resembling the body of a serpent, a tail and body having the proportions of an ordinary quadruped, and the paddles of a whale. These also grew to a length of more than twenty-two feet. More than twenty species of these long necked sea-lizards are known to geologists.

Was there ever an age of dragons? Tradition says there was, but there is every reason to believe that the fierce and bloodthirsty creatures, of which such a variety present themselves, are but creatures of the imagination based, no doubt, on the huge uncouth reptiles of the present human era, such as crocodiles and other creatures. Nevertheless in spite of all manifest absurdities of the dragons of various nations and times, geology reveals to us that there once lived upon this earth reptiles so great and uncouth that we can think of no other but the time honored word "dragon" to convey the slightest idea of their monstrous forms and characters. The dinosaurus was an order comprising the largest reptiles that ever lived; and while some of them in a general way resemble crocodiles, others show in the bony structures they have left behind a very remarkable and interesting resemblance to birds of the ostrich tribe.

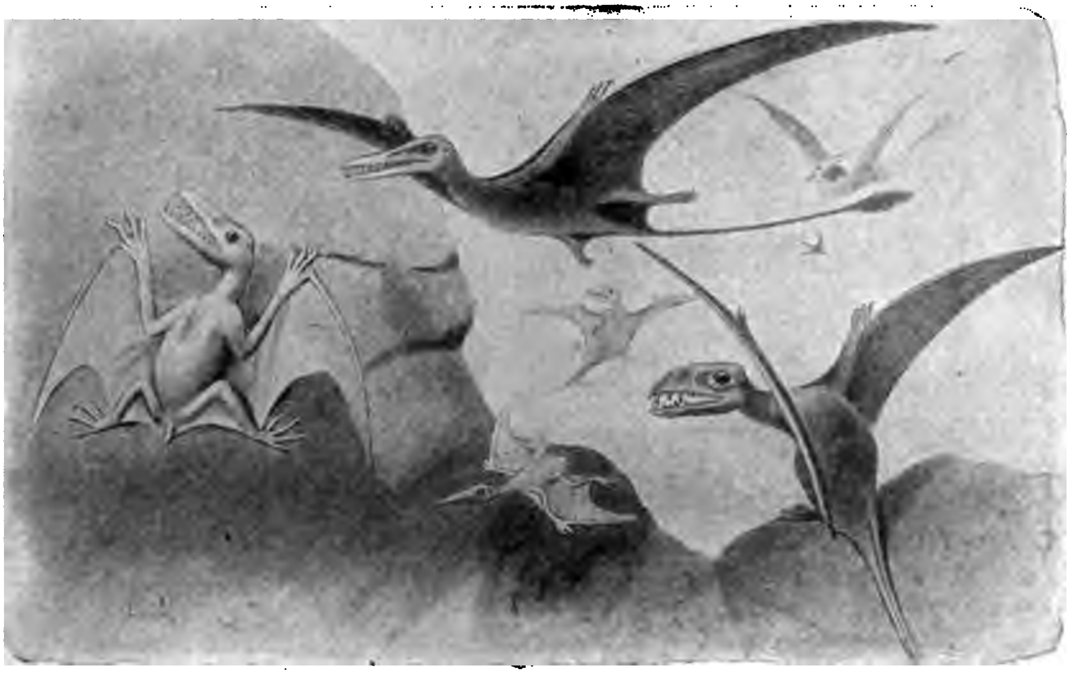
A GIGANTIC HORNED DINOSAUR. LENGTH, ABOUT TWENTY-FIVE FEET.

Their remains are found not only in Europe, but in Africa, India, America and even in Australia. The geologist finds that they reigned supreme on the earth throughout the whole of the great mesozoic era. Their bodies were in some cases defended by a formidable coat of armor, consisting of bony plates and spines, thus giving them a decidedly dragon-like appearance. They all had four limbs and in many cases the hind pair were very large compared to the fore limbs. The largest of the family were truly colossal in size, far excelling the rhinoceros and elephant of to-day.

One division of this family was the

brontosaurus, a vegetable feeding lizard. It was nearly sixty feet long and probably, when alive, weighed more than twenty tons. Each track made by the creature in walking occupied one square yard in extent. Its remains are found in the jurassic rocks in Colorado. Another member of the dinosaur family, the atlantasaurus, must have obtained a length of over eighty feet, and assuming that it walked upon its hind feet, a height of thirty feet. A thigh bone of one of these has been found entire, and it measures six feet and two inches in length. Colorado has yielded large numbers of most interesting fossils of this variety. Some of them were carnivorous, and some were diminutive creatures only two feet in length.

In addition to the dinosaurs or land dragons, there was another great order of reptiles that acquired the power of flying about like bats and flying foxes do now. The scientists called them pterodactyls, but they may very properly be termed "flying dragons." Some were no larger than small birds, but the largest had a spread of wing, or rather of the flying membranes, of twenty-five feet. Imagine a flock of these hovering over an antediluvian landscape, in which the animal life below them was supplied by eighty-foot dinosaurs and sea scorpions six feet long. Skeletons of sea serpents to a length of eighty feet have been found in the fossil deposits of Kansas.

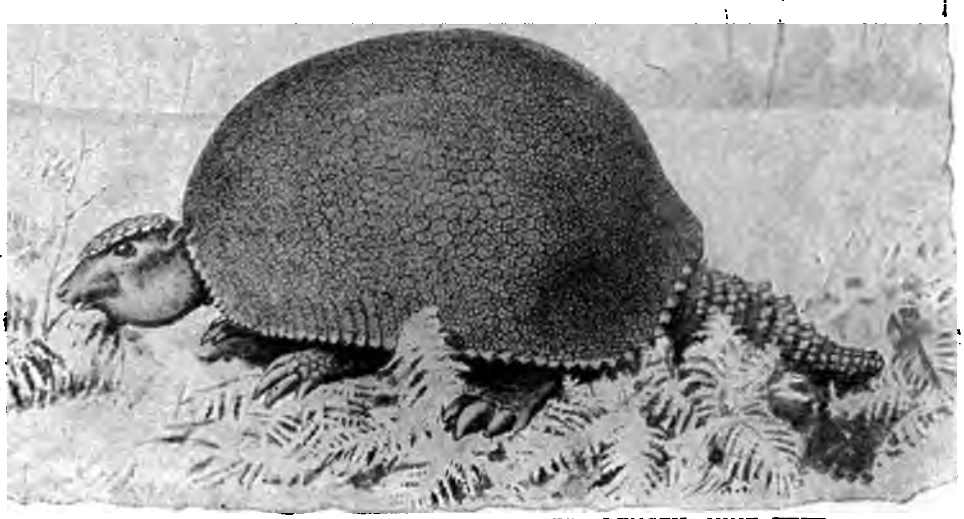


GROUP OF SMALL FLYING DRAGONS OR PTERODACTYLS.

Now we come to the great mammals of the past, animals not entirely unlike some that we know now, although immensely larger. America has been one of the most fruitful sources of information concerning these great creatures. In Wyoming have been found skeletons of a great animal called the tinoceras, which was akin to the rhinoceros, the elephant, the hippopotamus, and which measured about twelve feet in length without the tail. Its weight, when alive, is calculated to have been three tons. Great numbers of bones of these creatures have been found. Another equally picturesque creature found east of the Rocky Mountains was the brontops, still larger, with toes instead of elephant-like feet.

India, too, has yielded some strange monsters, including huge ones not unlike the moose of to-day, and a gigantic tortoise found complete as a fossil. From South America we obtain remains of gigantic mammals allied to sloths, ant-eaters and armadillos. The length of the best preserved specimen of these sloths is eighteen feet. The gigantic representative of the armadillo from South America is a huge armored creature more than eight feet long.

The mammoth and the mastodon are the creatures of the past whose names are most familiar to us, because they have come into the language and because they are not so long extinct as some of the strange creatures heretofore described. Approximately whole specimens of these primeval elephants have been found in the frozen regions of Siberia, preserved in the ice. The mammoth, indeed, has been actually seen in the flesh, and not only seen but eaten both by men and animals, although the meat had been frozen perhaps for several centuries. Fossils, remains of these elephants, have been found in Europe, Africa, Asia and North America. There is to-day a large trade in the ivory of the mammoth from Siberia, both eastward to China and westward to Europe. Various islands along the Siberian coast yield the huge tusks in great number. The most perfect specimen exists in the museum of



A GIGANTIC ARMADILLO, FROM BUENOS AYRES. LENGTH, NINE FEET.

the St. Petersburg Academy, the skeleton complete all except one leg, the skin still attached to the head and feet, and a large quantity of the hair remaining. This mammoth was discovered frozen in 1801 on the north coast of Siberia, and after several years was brought to St. Petersburg and mounted there. It had come to light by the thawing of a great block of ice which had covered it, and the people of the neighborhood had cut off the flesh and fed their dogs with it for two years before it was finally protected in the interest of science, and brought to Europe. There are at least nine cases on record of the discovery of frozen mammoths in northern Siberia, and it is not likely that the huge animal is long extinct.

The mastodon was similar to the mammoth, but probably preceded it in time. There is reason to think that in America it was contemporary with man in the prehistoric age. Numbers of partial specimens have been found in Kentucky, Ohio, Missouri, and other parts of the United States.

Of all the monsters that ever lived on the face of the earth, the giant birds were perhaps the most grotesque. New Zealand contributes the giant moa, a bird which stood twelve feet in height. The natives who were living at the time of the first white settlement of New Zealand, about 1840, declared the bird to be still in existence, but it cannot be learned that any white man actually saw the living creatures, although a search was made for them. However, fragments of shell and feathers were found with the bones of the birds, so that it is quite certain they had not been long extinct. In 1882 the head, neck, two legs and feet of a moa were found in a cave, having the skin still preserved in a dried state covering the bones, and some few feathers of a reddish hue still attached to the leg. In the island of Madagascar, also, the remains of a giant bird and its eggs have been found. One of the eggs had a diameter of fourteen inches, and would contain more than two gallons, or as much as three ostrich eggs or 148 hen's eggs.

The remains of a deer have been found in Ireland measuring in height to the summit of the antlers, ten feet, with a spread of the antlers from tip to tip of eleven feet.

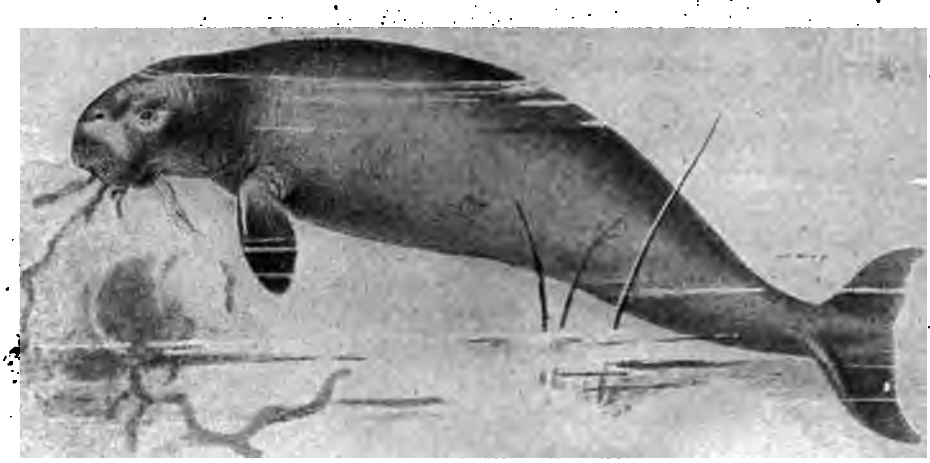
It has been possible at this time to give only the briefest mention of some of the strangest and most gigantic of the extinct monsters which once inhabited this earth. They are all recognized as absolutely authentic by scientists, testified by the incontrovertible proof of their remains, fossil or otherwise. In the era that preceded the birth of man, when animal life took these strange forms and vegetation was hardly less grotesque and gigantic in comparison with the world of to-day, is a field for study of unending interest and variety. What would we not give for actual landscape photographs of those wonderful scenes!

MAN AND NATURE BEFORE THE DELUGE

It is an accepted fact that the science of the earth and the wonders of nature have their culmination and terminus in man, the final link in the chain of life. A famous Canadian geologist, Sir J. W. Dawson, in one of his works makes an interesting study to answer the question, if possible, how and when this chief cornerstone was placed upon the edifice of nature. He puts this in the form of a narrative, based on geological facts only, and from his chapter on the subject of early man, the following paragraphs are condensed.

The glacial age had passed away. The lower land, in great part a bare expanse of mud, sand and gravel, had risen from the icy ocean in which it had been submerged, and most of the mountain tops had lost their covering of perpetual snow and ice. The climate was ameliorated and the sun again shone warmly on the desolated earth. Gradually the new land became overspread with a rich vegetation, and was occupied by many large animals. There were species of elephant, rhinoceros, horse, bison, ox and deer, multiplying until the plains and river valleys were filled with their herds, in spite of the fact that they were followed by formidable carnivorous beasts, fitted to prey on them.

At this time, somewhere in the warm temperate zone, in an oasis or island of fertility, appeared a new thing on the earth. A man and woman, walking erect in the forest glades, bathing in the waters, gathering and tasting every edible fruit, watching with curious and inquiring eyes the various animals around them, and giving them names which might eventually serve not merely to designate their kinds, but to express actions and emotions as well.



STELLER'S SEA COW. LENGTH, THIRTY-FIVE FEET.
Found alive by Steller at Behring's Island in 1741, but extinct since that time.

How this event happened, science is still unable to answer, and though we may frame many hypotheses, they all remain destitute of certain proof in so far as natural science is concerned. We can here only fall back on the old traditional and historical monument of our race, and believe that man, the child of God and with God-like intellect, will and consciousness, was placed by his maker in an Edenic region and commissioned to multiply and replenish the earth. The when and where of his introduction, and his early history, when introduced, are more open to scientific investigation.

That man was originally frugivorous, or fruit- and grain-eating, his whole structure testifies. That he originated in some favorable climate and fertile land is equally certain, and that his surroundings must have been of such a nature as to give him immunity from the attacks of formidable beasts of prey also goes without saying. These are all necessary conditions of the successful introduction of such a creature as man, and theories which suppose him to have originated in a cold climate, to struggle at once with the difficulties and dangers of such a position are, from the scientific point of view, incredible.

But man was introduced into the wide and varied world, more wide and varied than that possessed by his modern descendants. The earliest men that we certainly know inhabited our continents when, as we know, from ample geological evidence, the land of the northern hemisphere was much more extensive than at present, with a mild climate and a rich flora and fauna. If he was ambitious to leave the oasis of his region, the way was open to him, but at the expense of becoming a toiler, an inventor and a feeder on animal food, more especially when he should penetrate into the colder climates. The details of all this as they actually occurred are not within the range of scientific investigation, for these earlier men must have left few if any monuments, but we can imagine some of them.

Man's hands were capable of other uses than the mere gathering of food; his mind was not an instinctive machine like that of the lower animals, but an imaginative and inventive intellect, capable of adapting objects to new uses, peculiar to himself. A fallen branch would enable him to obtain the fruits that hung higher than his hands could reach. A pebble would enable him to break a nut too hard for his teeth. He could easily weave a few twigs into a rough basket to carry the fruit he had gathered, to the cave or shelter or spreading tree or rough hut that served him for a home; and when he had found courage to snatch a branch from some tree ignited by lighting, and to kindle a fire for himself, he had fairly entered on that path of invention and discovery which has enabled him to achieve so many conquests over nature.

Our imagination may carry us yet a little farther with reference to his fortunes. If he needed any weapon to repel aggressive enemies, a stick or club would serve his purpose, or, perhaps, a stone thrown from his hands. Soon, however, he might learn from the pain caused by the sharp flints that lay in his path the cutting power of an edge, and armed with a flint chip held in the hand or fitted into a piece of wood he would become an artificer of many things, useful and pleasing. As he wandered into more severe climates where vegetable foods could not be obtained throughout the year, as he observed the habits of beasts and birds of prey, he would learn to be a hunter and a fisherman and to cook animal food, and with this would come new habits, wants and materials as well as a more active and energetic mode of life.

He would also have to make new weapons and implements, axes, darts, harpoons, scrapers for skins, and bodkins or needles to make skin garments. He would use chipped flint where this could be procured, and, failing this, splintered and rubbed slate, and for some uses bone and antler. Much ingenuity would be used in shaping these materials, and in the working of bone, antler and wood, ornaments would begin to be studied. In the meantime, the hunter, though his weapons improved, would become a ruder and more migratory man, and in anger or in desire to gain some coveted object, might begin to use his weapons against his brother man. In some more favored locations, however, he might attain to a more settled life, and he, or more likely the woman, his helpmate, might contrive to tame some species of animals and to begin some culture of the soil.

It was probably at this early time that metals first attracted the attention of man. The ages of stone, bronze and iron believed in by some archæologists are more or less mythical to the geologist, who knows that these things depend more on locality and on natural products than on stages of culture.

Probably all these ends had been to some extent and in some localities attained in the earliest human period, when man was contemporary with many large animals now extinct. But a serious change was to occur in human prospects. Hilltops, long denuded of the snow and ice of the glacial period, were again covered, and cold winter sealed up the lakes and rivers and covered the ground with wintry snows of long continuance. With this came a change in animal life and in human habits. Now began a fierce struggle for existence in the more northern districts inhabited by man, a struggle in which only the hardier and ruder races could survive, except, perhaps, in some of the more genial portions of the warm temperate zone. Men had become almost wholly carnivorous, and had to contend with powerful and fierce animals. Tribe contended with tribe for the possession of the most productive and sheltered habitats. Thus the struggle with nature became aggravated by that between man and man. Violence disturbed the progress of civilization, and favored the increase of power of the rudest tribes, while the more delicately organized and finer types of humanity, if they continued to exist in some favored spots, were in constant danger of being exterminated by their fiercer and stronger contemporaries.

In mercy to humanity this state of things was terminated by a great physical revolution, the last great subsidence of the continents, that post-glacial flood which must have swept away the greater part of men and many species of great beasts, and left only a few survivors to repeople the world, just as the mammoth and other gigantic animals had to give place to smaller and feebler creatures. In these vicissitudes it seemed determined, with reference to man, that the more gigantic and formidable races should perish, and that one of the finer types should survive to repeople the world.

Thus we have followed, as closely as sci ence can interpret the chronicles, the progress of mankind from the creation to the deluge, and his development of the natural conditions in which he found himself. It is a fascinating study and an inexhaustible one. As the poet has aptly said, "The proper study of mankind is man," and these pioneers of our race are entitled to full attention in connection with the other wonders of the natural world, which we have inherited from them.

FLAGS OF ALL NATIONS.

FLAGS OF ALL NATIONS.

BOOK V

THINGS WE ALL SHOULD KNOW

CIVIL SERVICE AND ITS LAWS

Properly speaking, civil service means the service of all persons in the employ of government, national, state or municipal, except those in the army and navy. Civil service, therefore, existed from the time of the foundation of the government. But civil service reform, growing out of the abuses that were saddled upon public office, is of comparatively recent growth in this country. The general practice in the national government was that with every change of presidents from one party to another, there should be a clean sweep of all employes under the government, irrespecttive of merit, age or period of service, with the broad rule applied, "to the victors belong the spoils."

Finally it began to be recognized that there should be no "spoils," that "public office is a public trust," that faithful and competent service should assure permanence, and that the whole system in effect was unnatural and unwise, as well as highly improper. Earnest men, true patriots, began to plan for improvement, and now the country sees less and less of the unseemly scrambles for official place and plunder that used to be the chief evil of changing administrations.

The act of January 16, 1883, popularly known as the civil service act, is entitled "An act to regulate and improve the civil service of the United States." Its purpose, as its title indicates, was to correct certain conspicuous abuses which were then prevalent in connection with the appointment and promotion of civilian employees in the executive branch of the government, and at the same time to improve that part of the public service by increasing the efficiency of the employes, and thus securing a more satisfactory and economical administration of public affairs. In the departments at Washington the classification embraced all persons receiving salaries of not less than $900 nor more than $1,800 a year—altogether 5,652—of whom 135 were excepted from examination. The classification of the Customs Service embraced places having an annual compensation of $900 or over, at ports where 50 or more persons were employed, excluding only those whose nominations had to be confirmed by the Senate. The number of places thus classified, including eleven ports, was 2,573. The number of postoffices classified—being those at which there were 50 or more employes—was 23, and the classified service at these offices included all persons above the grade of workman or laborer except the postmasters, or 5,699 in all. In the three branches of the classified service, therefore, the total number of places made subject to the provisions of the civil-service rules was 13,924. By March 3, 1885, President Arthur, under whom this act became a law, had extended its operations to include 15,573 places. By March 3, 1889, President Cleveland caused it to include 27,330 classified places. By March 3, 1893, President Harrison had extended it to 42,928 places. At this time Secretary Tracy, with the approval of the President, put the Navy Yard Service under the merit system, thus classifying about 5,000 employes. By March 3, 1897, President Cleveland caused the act to cover 81,889 classified places. By June 30, 1901, President McKinley had added 2,233 places to the civil-service list, and under his administration, under various rulings, there were 19,423 places dropped from the merit system and restored to the list of purely appointive offices.

President Roosevelt caused nearly all of the more important places to be restored, and extended as rapidly as possible the merit system over the newly acquired dependencies and colonies.

EXTENT OF THE SERVICE.

It is estimated that the number of positions in the Executive Civil Service is now about 210,000, of which approximately 90,000 are classified competitive positions, 100,000 unclassified, and somewhat less than 20,000 are classified but not subject to competitive examination. Less than 20,000 of the official force are employed in Washington, D. C. Most of the unclassified positions are held by fourth-class postmasters, of whom there are more than 72,000.

Under the act of April 12, 1900, the United States Civil Service supplanted the military service in Porto Rico. Inasmuch as the executive officers and employes under this act become a part of the Executive Civil Service of the United States, they are properly subject to the provisions of the Civil Service acts and rules. On July 5, 1900, the Secretary of the Treasury, with the President's approval, issued an order classifying and including within the provisions of the Civil Service law and rules the officers and employes in and under the Treasury Department of Porto Rico, excepting persons appointed with the advice and consent of the Senate and persons employed as mere laborers or workmen. On August 29, 1900, the Postmaster-General informed the Commission that the United States Postoffice Department, on May 1, 1900, assumed control of the free-delivery service at Mayaguez and San Juan, Porto Rico. The Commission approved the lists of carriers transmitted therewith and authorized the treatment of the offices as free-delivery offices.

On July 5, 1900, the Secretary of the Treasury issued an order classifying the employes of the Treasury Department in Hawaii. The order is similar in scope and language to that of the same date relating to Porto Rico.

On September 19, 1900, the United States Philippine Commission passed an act entitled "An act for the establishment and maintenance of an efficient and honest civil service in the Philippine Islands." In introducing the measure President Taft said:

"The purpose of the United States Government and the people of the United States in these islands is to secure for the Filipino people as honest and as efficient a government as may be possible. It is deemed by the Commission and by the Government which the Commission represents to have every feature of this bill consistent with the Government. The danger in any government, whether it be republican or monarchial, is that public office be used for private purposes. All countries have suffered from this evil, and those countries in which a thorough system of civil service is selected are the first to minimize that danger."

HOW TO ENTER THE CIVIL SERVICE.

Persons seeking to be examined must file an application blank. The blank for the Departmental Service at Washington, Railway Mail Service, the Indian School Service, and the Government Printing Service should be requested directly of the Civil Service Commission at Washington. The blank for the Customs, Postal, or Internal Revenue Service must be requested in writing of the Civil Service Board of Examiners at the office where service is sought. These papers should be returned to the officers from whom they emanated.

Applicants for examination must be citizens of the United States, and of the proper age. No person using intoxicating liquors to excess may be appointed.

A set of specimen examination questions covering all the departments has been prepared by the Commission, with full information as to examinations. This is published in a pamphlet under the title, "Manual of Examinations," and may be obtained free of charge by writing to the United States Civil Service Commission, Washington, D. C. It can also be obtained from any postoffice where there is a civil service department.

The age limitations for entrance to positions in the different branches of the service are as follows:

	Minimum.	Maximum.
Departmental service:		
Page, messenger boy, apprentice, (other than apprentice in mints and assay offices) or student	14	20
Apprentice in mints and assay offices	18	24
Printer's assistant and messenger	18	No limit.
Positions in the Railway-Mail Service.	18	35
Internes and hospital stewards in the Marine Hospital Service and acting second assistant engineer in the Revenue-Cutter Service	21	30
Keeper, assistant keeper and officers of light-house tenders and light vessels in the Light-House Service	18	50
Cadet in the Revenue-Cutter Service and aid in the Coast and Geodetic Survey	18	25
Surfman in the Life-Saving Service	18	45
Superintendent, physician, supervisor, day-school inspector, disciplinarian, matron, and assistant matron in the Indian Service; inspector and assistant inspector of hulls and inspector and assistant inspector of boilers in the Steamboat-Inspection Service	25	55
Observer in the Weather Bureau Service	18	30
All other positions	20	No limit.
(The age limitation shall not apply in the case of the wife of the superintendent of an Indian school who applies for examination for the position of teacher or matron.)		
Custom-House Service: All positions	20	No limit.
Post-Office Service:		
Rural letter carrier	17	55
All other positions	18	45
(The age limitations shall not apply in the case of an honorably discharged United States soldier or sailor of the civil war or of the Spanish-American war who applies for the position of rural letter carrier.)		
Government Printing Service:		
All positions (male)	21	No limit.
All positions (female)	18	No limit.
Internal-Revenue Service: All positions.	21	No limit.

The inestimable value of the merit system to good government is now so universally admitted, and so unassailable from both moral and economic standpoints, that it is being extended throughout the entire field of public service.

Civil Service on the merit system in the cities is making notable progress, as in Chicago, New York and Boston, while in other cities it is still struggling against the spoils system of the professional politicians.

The merit system of the Civil Service is likewise making notable progress among the States, as in New York and Massachusetts, where a practical economic system is now in effective operation.

Likewise many counties of the various

States have adopted civil service rules in which there shall be "no dismissal except for cause, no promotion except for merit." In this way the office spoilsmen among professional politicians can not cause the dismissal even of a janitor without due trial and conviction of a misdemeanor.

COMPULSORY EDUCATION

Most of the States of the Union, and the District of Columbia, have compulsory education laws under various conditions, many of them made partly ineffective by exceptions.

In Ohio the law is inoperative where the seating accommodations of the school houses are insufficient.

In Massachusetts, the four Cape Cod counties and the mountain counties of the west are exempt.

In the various States, required attendance varies as to age from 7 years to 16 years. The prevailing limits are 8 to 14 years, and as to time, from eight weeks in Kentucky to the entire term taught in Massachusetts and Connecticut.

Where the penalty is on the parent, it varies in fines from $1 in New Mexico to $200 for repeated neglect in Nevada.

The penalty is in numerous places on the child. In Maine if the child is between 10 and 15 years of age and guilty of repeated truancy, it is sent to the reform school; in New Hampshire to industrial school; in Massachusetts, between 7 and 16, to truant school; in Rhode Island to any designated institution; in New York to truant school; in New Jersey to juvenile reformatory, if over 9 years of age; in Pennsylvania to local truant school; in Ohio to a reformatory; in Indiana to a parental home provided by the school board; in Michigan to an ungraded school provided by the board.

Penalties varying from $10 to $100 for non-enforcement of the law are set upon officers in the states of Maine, Vermont, Pennsylvania, West Virgina, Kentucky, Ohio, Wisconsin, Minnesota, North Dakota, South Dakota, Kansas, Montana and California.

In most of the states where there are state institutions for the deaf, dumb and blind, there is compulsory attendance at the parents' expense if they are able.

Exemptions from compulsory attendance are granted for distance from nearest school as follows: California, one mile; Pennsylvania, Kentucky, West Virginia, Indiana, Michigan, Wisconsin, Minnesota, Kansas, Colorado, Nevada and Oregon, two miles; North Dakota, Montana, Utah, two and one-half miles; Idaho, three miles.

A physician's certificate for bodily or mental ailments will exempt children in Indiana, North Dakota, Montana, Wyoming, New Mexico and Utah. In Washington defective children must be sent to state institutions. Poverty is an exemption in the District of Columbia, Nebraska, Rhode Island, Kentucky, Minnesota, Kansas, Montana and California.

The need of the child's service for support of parents exempts it from attendance in Utah, and, for any relative, in Illinois.

Any urgent reason exempts from the law in Pennsylvania and Wyoming.

In Wisconsin and Illinois it is necessary to obtain a decision from a court of record.

In Ohio, the decision of a probate judge on appeal will exempt.

By enactment of the legislatures, in case of poverty, clothing and books are furnished free in Vermont, by the town; in Indiana by the county; and in Colorado by the district. Elsewhere certain local provisions are made for the same purpose.

The following states have made legal provisions for transporting children to school at public expense: Maine, New Hampshire, Vermont, Massachusetts, Connecticut, New York, New Jersey, Iowa, North Dakota and Nebraska, while partial provisions are made in Rhode Island, Wisconsin, Ohio, Pennsylvania and South Dakota.

CHILD-LABOR LAWS.

In New Hampshire, no child under 10 years of age may be employed in a manufacturing establishment, nor one under 16, who cannot read and write, during time schools are in session, under a penalty on the employer not to exceed $30.

In Vermont no child under 14 years is to be employed in any mill or factory unless he has a certificate of school attendance of 14 weeks in the year.

In Massachusetts no child under 14 years of age can be employed during the school term, nor for any work earlier than 6 A. M. or later than 7 P. M. No one under 16 can be employed during school term without a certificate of attendance for the required time, nor any minor over 14 who cannot read and write, during the time when there is a local evening school, unless he shall be attending the same. The penalties on employers are from $5 to $50.

In Rhode Island no child under 12 years can be employed during the school year without a certificate of having attended school eighty days. Fines not to exceed $20.

In Connecticut no child under 14 can be employed who has not a certificate of sixty days' attendance at school. Penalty not to exceed $60.

In New York no child under 12 can be employed during school term, nor for the next two years without a certificate of eighty days' attendance. Penalty $50.

In New Jersey no child under 15 years can be employed without a school certificate for twelve weeks of consecutive attendance. Penalty $10 to $25 or imprisonment one to three months.

In Ohio no child under 14 years can be employed without a certificate of sixteen weeks' attendance. Penalty $25 to $50.

In Illinois no child shall be employed which is under 13 years, for any period of time greater than one day, without a certificate from the school board that the child's service is necessary to support an infirm relative. Penalty, every day being an offense, $10 to $50.

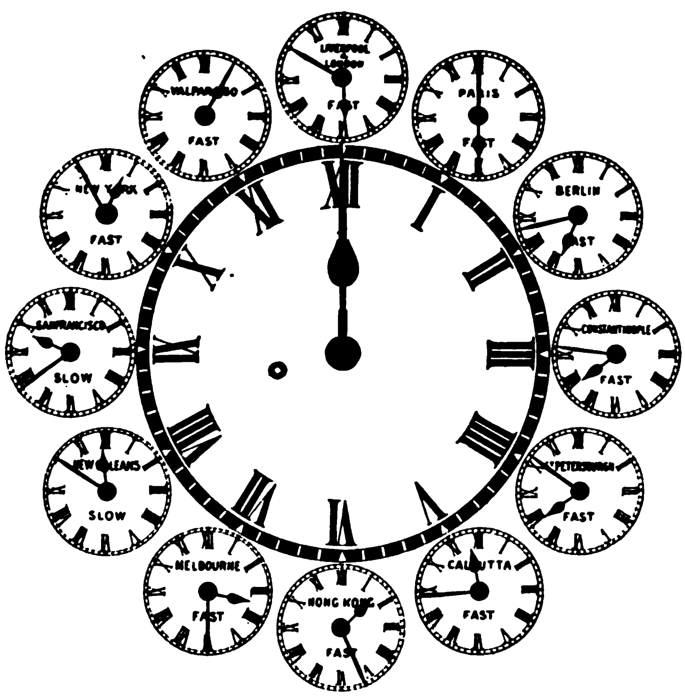
In Michigan every child under 14 years must have attended school four months immediately previous to employment. Penalty $5 to $10 for first offense and not less than $10 for each subsequent offense.

In North Dakota and South Dakota no child under 14 can be employed, except by parents or guardians, while the local public schools are in session, without certificate of twelve weeks' attendance. Penalty $20 to $50 and costs in North Dakota, and $10 to $20 in South Dakota.

STANDARD TIME OVER THE WORLD

When transportation was slow and of small amount, the question of differences in time was of small account, but with the advent of swift movements along parallels of latitude, in the vast volume of traffic of recent years, the problem became one of intolerable perplexity and danger.

Scientific discussion had been going on for years with many suggestions and plans for relief, when in 1884, a conference was held in Washington which divided the world into zones or time belts with the meridian of Greenwich, five miles southeast of London, as a basis. The observatory at Greenwich, which is almost universally the calculating point for the geographical measurements of longitude, was erected by Charles II. for the advancement of navigation and nautical astronomy. It now transmits the time by magnetic currents to all England and is the chief nautical reckoning point for the rest of the world.



CLOCK INDICATING SIMULTANEOUS TIME AROUND THE WORLD.
The center dial represents noon at Chicago and a corresponding variation may be calculated for any hour in the day.

Before the general establishment of what is known as standard time, each town on a given parallel had a different time from that of its neighbor, in accordance with the movement of the sun, but to the confusion of all railroad time. For the public convenience, the United States was divided into four sections or belts of 15 degrees, or one hour each, to be known as Eastern, Central, Mountain and Pacific time. To accommodate the general divisions of the railroads, the dividing lines are drawn irregularly from north to south through railroad terminals or principal towns. On that account, Eastern time includes all the territory between the Atlantic coast and a line drawn from Detroit to Charleston, South Carolina. Central time includes all west to the irregular line drawn from Bismarck, North Dakota, to the mouth of the Rio Grande. Mountain time extends to the western borders of Idaho, Utah and Arizona, while the remainder west is Pacific time. Thus twelve noon in Eastern time is eleven a. m. in Central, ten a. m. in Mountain and nine a. m. in Pacific time. This is easily understood from the fact that it requires an hour for the sun to pass over a little more than a thousand miles, therefore the sun rises upon or is perpendicular over, the eastern end of a thousand miles one hour before it is in the same position at the western end. Standard time for the United States is supplied by the Naval Observatory at Washington. The exact hour of twelve o'clock noon is determined every day by astronomical observation, and the precise time is transmitted to the clocks of the government departments by electricity. The telegraph companies are permitted to telegraph the time thus taken by automatic instruments to all parts of the United States. The instrument at San Francisco registers the time within a fifth of a second after it is taken at Washington, D. C. To do this the telegraph company clears all its wires throughout the United States of all business, three minutes before noon each day, and thus unbroken connection is established over the entire telegraph system of the country.

Not alone is the exact time sent instantly to all parts of the Union, but the extensive system of private and business clocks connected with the telegraph lines are, by an electrical device, regulated together. This is done in each clock by means of an electro-magnet operating a clamp. The magnet is filled with electric force when the circuit is closed to give the noon signal, and the hands of the clock are forced to the exact point of twelve. The telegraph company charges $15 a year for each clock and fully $1,500,000 a year is earned by this service. More than ten thousand clocks are thus regulated in New York City alone.

From the staff of the Naval Observatory at Washington a great red ball drops exactly at noon every day, and those seeing it can regulate their watches and clocks accordingly. In seaport towns balls are dropped in the same manner and the seamen can thereby regulate their watches.

PUBLIC LIBRARIES, THEIR GROWTH AND ADMINISTRATION

The administration of a great library, in order to make it most serviceable to those who patronize it, has become one of the learned professions of late years, so rapid has been the growth of the institutions and the uses to which they are put. Architects make special preparation to qualify themselves for the building of libraries. Colleges and universities give special courses for the instruction of librarians in the various departments of their work. Philanthropists have learned that there is no use to which they may put their benefactions for the public good surpassing the gift of funds for the establishment or the extension of libraries, and the reading public, realizing the remarkable advantages to which it has access since libraries so multiplied, gives closer attention to literature and keeps the attendants busy serving the wants of those who love books.

In 1900 there were in the United States 5,383 public, society and school libraries containing 1,000 or more volumes each. The total number in these collections was 44,591,851, or 35 per cent more than in 1896, when the number was 33,051,872. There is one library of more than 1,000 volumes for every 14,118 persons, and there are fifty-nine books for every one hundred of the population. All of these figures entirely exclude all private and small collections, which would increase the total enormously, for there are multitudes of private libraries exceeding 1,000 volumes.

There are fifty-three national and state libraries, of which the Library of Congress, at Washington, is the largest, with more than 1,000,000 volumes. In addition to this library the House of Representatives, the Senate and the various departments of the government have their

LIBRARY BOOK STACK ROOM.

special collections of books for immediate use, so that the total number of volumes belonging to the government in Washington exceeds 2,000,000. The largest of the state libraries is that of New York, at Albany, with 423,290 volumes.

Of the thirty-six free public libraries of 50,000 or more volumes, that of Boston is the largest, with 772,432 books on its shelves. Thirty-two universities and colleges have libraries of more than 50,000 volumes, and of these Harvard University stands at the head with 560,000 books. There are thirty-seven other libraries in the United States exceeding 50,000 volumes each, belonging to various societies and special collections and extending in several instances to more than 200,000 books.

It is edifying to notice a single city as an example of the wealth of library material in the United States. In Chicago the free public library has a total of 272,276 volumes and 49,805 unbound pamphlets. The aggregate circulation for a single year approaches 2,500,000 volumes, which does not include the use of books kept on open shelves, nor the periodicals and newspapers used in the reading rooms. The splendid public library building which shelters this collection was erected at a cost of several hundred thousand dollars, and is equipped with every modern appliance known to library experts. Of course, it is fireproof throughout, being built entirely of steel,

DYNAMOS AND VENTILATING PIPES, CHICAGO PUBLIC LIBRARY.

cement, glass and tiles. The book stacks or shelves are made of steel. The ventilation of the library is arranged according to a system which makes it unnecessary to open the windows and admit the dust and soot, which are so disastrous to books. All air for ventilation is admitted through the basement, where it is filtered and cleaned before being distributed throughout the building by an intricate system of large pipes and fans.

In addition to this library, in Chicago there is the John Crerar library, with more than 75,000 volumes, the Newberry free library with 250,000 volumes, the Chicago Historical Society library with 27,000 volumes and 60,000 pamphlets, the Chicago Law Institute library with 40,000 volumes, the University of Chicago library with 335,000 volumes and 165,000 pamphlets, the Field Columbian Museum library and the library of the Armour Institute, each containing some 15,000 volumes. It is evident that no one need be denied reading matter in such a city for want of opportunity, and the other great cities of the United States make a showing equally creditable.

Andrew Carnegie, the great iron master, has paid special attention to public libraries in his immense contributions to charitable and educational purposes. It is calculated that he has given nearly $15,000,-000 for libraries in the United States and Scotland within the last two or three years. To New York city alone he gave $5,200,-000 to establish branch libraries. To St. Louis he gave $1,000,000 for a public library, and to a total of nearly two hundred cities he has given public libraries ranging in cost from $15,000 to $750,000. In nearly every instance his gifts have been coupled with the condition that a building site should be provided free of cost, and an appropriation for the annual maintenance of the library be made from public funds. By this means he has stimulated the gift and the expenditure of large sums of money in addition to those which he gave himself, and consequently the totals of his own contributions do not by any means measure the full amount given for such purposes in this country. Indeed, there have been several other gifts of public libraries, ranging in value from $25,000 to $150,000, by men who avowed themselves to be moved by Mr. Carnegie's generosity elsewhere, so that to him must be given a large share in the credit for the remarkable stimulus that has been given to library building within recent years.

AMERICAN COLLEGES AND THEIR GROWTH

It is a characteristic of this age of progress that attention is being paid to the intellectual side of life just as energetically as to industrial and commercial undertakings. Indeed, in many communities the development of the refinements of life is advancing with even greater rapidity. In the comparatively new cities of the Mississippi Valley and the Far West the men of energy and ability, until recently, have been forced to devote all their time and attention to the upbuilding of their own prosperity and that of the communities in which they live. They have had little leisure to think of anything except business. Of late years, however, with their fortunes established and business conditions fixed in more regular channels, they have had more lib-

year are in large degree attracted by the athletic successes of the respective institutions.

It is impressive to note the immense gifts that have been made within the last few years to certain colleges and universities by some of our wealthy Americans. Andrew Carnegie has given $10,000,000 to establish the University of the United States at Washington, and $10,000,000 to the Scotch universities, all within a single year. John D. Rockefeller, in the same year, 1901, gave $2,000,000 to American colleges, and within ten years has given to the University of Chicago approximately $8,000,000. Mrs. Stanford, in 1901, gave to Leland Stanford Junior University in California, property valued at $30,000,000, and the bequests of her husband and her own gifts prior to that time had already amounted to many millions. Mrs. Hearst gave to the University of California property amounting to more than $10,000,000. Cecil Rhodes in his will left sums amounting to $20,000,000 to assist the cause of education in the English universities, this amount to be available as scholarship funds for students from England, the British colonies and the United States. D. K. Pearsons of Chicago has given more than $3,000,000 to colleges throughout the United States within the last few years. Mrs. Joseph L. Newcombe in 1901 gave $3,000,000 to Tulane University at New Orleans.

The foregoing are but the greatest gifts out of a long list. Several others could be named, amounting to $1,000,000 each, and scores of sums from $10,000 upward. In most cases the amounts were given on condition that the institutions to which the money was granted would raise similar sums through subscriptions from alumni and other friends, so that the amounts given in large sums have been virtually doubled by the raising of smaller amounts.

No one can fail to appreciate the great significance of such an educational movement. It is a recognized fact that education does more to advance the true welfare of a nation than any other influence that can be enlisted, and American colleges and universities have always been a factor of great importance in influencing the national life and policies on important questions at issue. With education multiplying as it is sure to do rapidly under the impetus given it during the closing years of the last century, we may expect to see even greater results in the future than there have been in the past.

AMERICAN COLLEGE SPORTS

Probably no other influence has been as effective in making athletic sports generally popular as has been the great interest taken in them by the young men of American colleges. Leading a studious life through a large part of their time as they do, it is necessary for them to take every opportunity for outdoor exercise, for the sake of their health and the quality of their work. Stimulated to rivalry, first among themselves in their own colleges as they are, and then by loyalty to their institutions to rivalry with other neighboring schools, the spirit of emulation has grown, until now the annual competitions and events in athletic sports have become almost a supreme factor in the college year to hosts of young men.

In the fall, each year, football holds the place of highest importance, and in the spring baseball takes a corresponding rank.

As incidental factors throughout the year come contests in tennis, track athletics, gymnasium athletics, rowing, and other sports.

BRINGING OUT THE SHELL.

There are many colleges which do not have access to water, and consequently cannot enter the rowing competition. Those which are located more favorably, however, either at the seashore or beside some lake or river, find in these contests one of the most important events of the year and one which attracts to it thousands of visitors from far away. The "big race" every year, as it is considered in the college world, is that of the eight-oar crews of Yale and Harvard Universities, usually rowed at New London, Connecticut, on the Thames river. On the same day there is also a race between four-oar crews and freshmen crews from the same universities, and the three events serve to make the day an important one in college athletics. These, however, are not the only college crews that race every year, with great importance placed upon the victories. In this country Princeton, Columbia, Cornell, Pennsylvania and other eastern universities, and several of the large western colleges and universities arrange similar events, while in England the annual race between Oxford and Cambridge attracts world-wide interest.

The apparently frail craft in which these races are rowed cut through the water at an astonishing speed, the rowing records

THE POLE VAULT.

for college teams being as low as four miles in a few seconds more than twenty minutes.

Almost every American college and school, from Harvard and Yale down to the smallest village grammar school, has its series of games for the football championship every fall. When Harvard and Yale, Princeton and Columbia, or Pennsylvania and Cornell play their annual game, whether it be in New York, Boston or elsewhere, on Thanksgiving day, thousands of enthusiasts make riotous applause for the victors on whose strength and agility so much depends. In New York, for instance, 60,000 people have been known to be present at such a game. Thanksgiving day, indeed, has become known as the great day for football events the country over. This is one game into which professionalism has entered hardly at all, fortunately for athletic sports.

Another noteworthy game of football is that played between the cadet teams of West Point and Annapolis. It is the army against the navy in this instance, and the young cadets from the two national schools of warfare fight bravely to win the honor for their respective arms of the service. The same energy that they display at this time in a manly spirit of athletic rivalry is the quality which serves them well in later years when they enter more important undertakings in the service of their country. An accompanying illustration represents one of these games, played at Philadelphia on the field of the University of Pennsylvania. More than 30,000 spectators witnessed the spirited contest. Among them were President Roosevelt and the members of his cabinet, the members of the Senate and the House of Representatives, and a number of distinguished officers of the army and the navy. Many special trains ran from Washington, New York and the other neighboring cities to accommodate the immense crowds that desired to view the contest between the young men who are to be our future generals and admirals.

COLLEGE CREW IN AN EIGHT-OARED RACING SHELL.

OCEAN, LAKE AND MOUNTAIN RESORTS

In spite of the energy and fidelity with which Americans stick to their business at all hazards, there are few countries where great summer and winter resorts are more highly developed than they are in the United States. On the Atlantic coast, from Maine to New Jersey, a succession of beautiful summer resorts have grown up, where splendid hotels, attractive bathing beaches and the other conditions which make such places pleasurable, attract hundreds of thousands of visitors every year. At Atlantic City, New Jersey, is the dividing line between the winter and summer coast resorts, for here in both seasons visitors crowd the hotels. Further south it is chiefly winter travelers who patronize the seaside, all the way down to the tip of the Florida peninsula and thence around the coast of the Gulf of Mexico to the Texas cities themselves.

The coasts of the New England states, and Long Island, Delaware and New Jersey, are marked with charming resorts every few miles. Florida, with its splendid hotels facing the gulf, forms a distinct resort region of its own for the winter. From Mobile, Alabama, to New Orleans, facing the Gulf of Mexico, is a shore which the southerners term the American Riviera. On the Pacific another distinct group of resorts has developed, from San Diego in the south to Alaska in the north. San Francisco becomes the dividing line between the summer and winter resorts on this coast. Southward from the metropolis of California are such beautiful winter resorts as Monterey, Santa Barbara, Santa Catalina, Los Angeles and San Diego, while northward in the summer multitudes of tourists

FOOTBALL GAME BETWEEN ANNAPOLIS AND WEST POINT CADETS AT UNIVERSITY OF PENNSYLVANIA, PHILADELPHIA.
President Roosevelt, his cabinet, both houses of Congress and hosts of distinguished citizens were among the 30,000 spectators present. Special trains from New York, Washington and elsewhere helped to swell the crowd.

take advantage of the mountain and coast beauties of Puget Sound, British Columbia, and the Alaskan shores even further north. Monterey and Santa Catalina, likewise, are almost as popular in the summer as in the winter.

Between these two oceans a limitless variety of pleasure grounds await the vacation wanderer at any season. The mountains of New England, the Adirondacks, the Georgia pines, the lakes of Michigan, Wisconsin and Minnesota, the mountains of California and the far west offer choice inexhaustible. Nature has given to this country as lavishly of opportunities for pleasure in wholesome climates and among beautiful surroundings as it has given of the wealth of the forests, the mines and the farm. He would be exacting indeed who should fail to be satisfied in whatever direction he desired to use his activities of mind and body.

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WINTER SPORTS IN NORTHERN CITIES

Every country has sports peculiarly its own in the beginning, and those that are best for general use are invariably passed over the boundaries into neighboring countries for appreciative adoption there. It is to Canada, thanks to its cold but favorable winters, that the world owes the development of some of the most wholesome, enjoyable and picturesque of athletic sports. In Quebec, Montreal, Ottawa, Toronto, Winnipeg and a host of smaller cities of the Dominion of Canada, the winter is the season of greatest merriment, the time of most active outdoor life. The low temperature and the deep snow are themselves the factors of which the people take advantage to have their jolliest times.

BATHING BEACH, PIER, PAVILION AND THE FAMOUS BOARDWALK, ATLANTIC CITY, N. J.

Sleigh riding and coasting, which in the cities a little farther south are uncertain treats, here become the standard form of amusements through the long winters. The Canadian hills are gay with the bright costumes of multitudes of merry coasting parties. It is here that that most picturesque of snow craft, the toboggan, has been developed to the fleet vehicle used so generally, as a substitute for the ordinary sled with runners, on Canadian hills. The toboggan, indeed, of late years, has been introduced to a considerable extent into the United States, where it has gained much popularity. Instead of runners it has a smooth, polished surface for its whole width, and in an icy trough worn upon the steep hillside the coasters attain a breathless speed before they reach the bottom of the decline. Here, too, in all their picturesque beauty, are seen the gay costumes of many-colored blanket cloth worn as suits and dresses by the young men and women.

The snowshoe is another Canadian improvement of a primitive Indian invention. Over the deep snows which gather in the northern winters the snowshoes bear the sportsman without trouble, so that he may race or hunt at will, uninterrupted by the drifts.

Of course skating is as popular during the Canadian winter as it is in other countries where cold weather comes in earnest. The rivers and lakes, however, are usually covered with snow to such an extent that skating is virtually confined to large rinks which exist in every city, where brilliant illumination helps to make the scene within more gay than it might otherwise be.

Ice-boating, too, has its devotees in Canada. This inspiring sport, however, has its chief favor on the Hudson river and on some lakes of New York and Wisconsin.

CROWD ON THE FAMOUS BOARDWALK WATCHING BATHERS ON THE BEACH AT ATLANTIC CITY, N. J.

ON THE TOBOGGAN SLIDE—CANADA'S FAVORITE WINTER SPORT.

"THE BOUNCE."

Ice-boats are built in triangular form, resting on three skates, the one in the rear serving as a rudder. They have no cabins, and are but skeleton craft, sliding over the ice at railroad speeed and carrying a spread of canvas like that of a small yacht. Experts in handling ice-boats are able to maneuver them in any direction as readily as their cousins at sea are handled, and there is no more beautiful sight than a race between a fleet of these picturesque craft.

As a center of winter sport, and an attraction for multitudes of visitors, Quebec, Montreal, Winnipeg, St. Paul and one or two other cities at various times have built great palaces and castles of ice. Some of these have been noteworthy for their architectural beauty and grace no less than for their novelty. Balls and festivals, illuminations, fireworks, sham battles, and other sports more truly a part of winter festivities, have centered around them to make carnivals of winter which have attracted thousands of travelers from long distances to witness the novel and beautiful scenes.

If one has the instinct for outdoor pleasure, and is resourceful, he will discover that there is no season when nature does not offer some means of sport, both whole-

OVER THE HURDLE IN A SNOWSHOE RACE.

some and entertaining, and winter nowadays does not stand at the bottom of the list.

HORSE RACING THE WORLD OVER

Horse racing for many generations has been called the "sport of kings," and never has there been a time when the sport was more popular or more widely enjoyed than it is today. "It is differences of opinion that make horse races," said a clever writer, and there are few countries where the people do not differ as to the merits of their respective steeds, and back their judgment for a [illegible] the facts. It is hard to [illegible] a land so remote that horse races are not popular events in the year's sporting annals. In Melbourne, the temporary capital of Australia and the metropolis of [illegible] continent, is a race course in which the people take pride, claiming it to be the finest in the world. And there at Flemington, once a year, is run a race for a prize known as the Melbourne Cup, which attracts visitors not merely from all the neighboring colonies of Australia but actually from England and the United States as well. In this city of less than 500,000 inhabitants, 100,000 persons will gather at Flemington race course on the day of the Melbourne Cup race, and the prize to the winner of the race sometimes amounts to as much as $75,000.

Far on the other side of the world from Melbourne, in May every year, the people of London, and, indeed, strangers from all the world, gather at Epsom Downs to see the Derby. Unlike most race courses there is no charge made for entering the course at Epsom Downs and viewing the race, and thus, with free admission as a temptation,

"DERBY DAY" AT WASHINGTON PARK RACE COURSE, CHICAGO.

literally thousands of people spend the night before the race walking the twenty miles from London in order to be among the multitude present. Crowds approaching half a million have been known to be at Epsom on Derby day.

Across the channel from England the French in turn have taken up horse racing, and at Longchamps, near Paris, is a beautiful course where every year, a few days after the London Derby, is run another noteworthy race called the Grand Prix, or the race for the grand prize. Here gathers the fashion of Europe for the most famous day in the annual sporting calendar of Paris.

These three races, the Melbourne Cup, the Derby and the Grand Prix, contend for the honor of being the greatest race in the world. Here in America we have several which rival each other in importance in the sporting world, among them the Futurity and Suburban at Sheepshead Bay, New York, and the American Derby at Chicago, with two or three other races that might be named as of the highest interest to the lovers of the horse. These events attract more attention year after year. The American Derby, run every spring at the Washington Park race course in Chicago, has earned for its winner as much as $49,500 in stake money. Sixty thousand persons have been present to witness the race, and the display of splendid equipages and brilliant fashion makes it noteworthy even beyond the importance of the sporting event itself.

ARMIES AND WARS OF THE WORLD TODAY

In spite of the advance of education and enlightenment, the increased facility of

BENGAL LANCERS FROM INDIA ROUTING CHINESE CAVALRY NEAR PEKIN.

[illegible] and better acquaintance [illegible] nations of the earth, and the [illegible] material affairs in this indus- [illegible] cessation in the mili- [illegible] world. Of late years [illegible] between the great civ- [illegible] not been numerous, and [illegible] been hardly a year without its [illegible] and the United States, Greece

A BICYCLE BRIGADE IN THE BRITISH ARMY.

and Turkey, Great Britain and the Boers, have had their interchange of warfare. Japan and China fought over the Korean question. Various South American republics have engaged in wars, important enough to themselves and yet hardly noticed by the rest of the world.

In conflicts between the powers and the various savage or rebellious foes they have raised up to plague them there has been hardly any interruption. Great Britain, indeed, is never at peace, and at least one London paper has a standing head line, year in and year out, "our little wars," under which general title are recorded every year, fatalities that in their total would amount to the losses of a great battle. Egypt and the Sudan, Central Africa, South Africa, the Afghan hills, and indeed almost every place where England's colonial efforts come in contact with native races in possession resenting innovation, are scenes of frequent outbreaks against British rule.

France, likewise, in Senegal, Dahomey, Algeria, the Sudan, Madagascar and Indo-China, has had to fight its way for colonial power. Italy first succeeded and then failed disastrously in Abyssinia, and is now left with a fringe of barren coast on the Red Sea to show for the enormous losses of blood and treasure in the African campaigns.

Spain has seen her whole colonial possessions vanish, except a few worthless tracts at the edge of the desert in Western Africa, and from these she draws no profit. Belgium, with the Congo Free State, seems to be planning commercial development for that great tropical territory, but the end will be reached only with great labor and cost of men and money. Germany and Portugal, likewise, have Central African colonies, in every instance costing far more than they return, and even with the promise of ultimate profit there will be a long intervening period of bitter warfare with natives. Russia is constantly extending her boundaries southward, but has not yet any colonies or possessions except those of contiguous territory with the great empire itself.

We of the United States, fighting Spain to release Cuba from the yoke of oppression, found ourselves inheriting a war with the Filipinos, who were already demanding freedom from their Spanish oppressors. Within its first three years this war of ours with the Filipinos cost us immensely more in money and in men than the parent conflict with Spain itself.

So it is that all Europe, and indeed all the world, is rapidly becoming an armed camp. Nations have adopted the theory that safety can be assured only by eternal vigilance and military strength. The peace rescript of the Emperor of Russia, from which sentimentalists counted so much, was hardly circulated before there was such an outbreak of warfare as the world had not seen for many years. Great scientists and inventors are concentrating their attention upon improvements in the mechanism and

CAMEL-GUN WITH BRITISH ARMY IN THE SUDAN.

art of war. Improved rifles, projectiles and explosives of many varieties have altered the character of warfare on land almost as much as it has changed at sea. No longer are there spirited charges across open fields, or steady advances of regiment against regiment. With rifles effective at a range of one mile, and smokeless powder for the explosive, a force would be annihilated long before hand to hand fighting could begin. Artillery and long-distance firing, therefore, have supplemented close work with muskets. Balloons, war-kites, searchlights, machine guns, armored railway cars and other innovations have come into modern warfare. Field hospitals and ambulance systems likewise have been improved, but the happy time is not yet when the Red Cross will have no work to do, and the military organizations of the powers can release their millions of soldiers to some more profitable and productive vocation.

Some detailed information concerning the newest explosives, projectiles, guns and armies will serve to indicate the activities in this direction. Picric acid is obtained by the action of nitric acid on carbolic acid, and from it are made such remarkable destructive materials as dynamite, maximite, cordite and lyddite. The latter was the explosive most favored by the British in their campaigns against the Boers in South Africa. These high explosives, like smokeless powder, are not generally dangerous to handle. They must be prepared with detonating caps for the purpose of exploding them. The dum-dum bullet, a fatal projectile for small arms, is made of nickel, with a point of soft lead. When such a bullet strikes any object it spreads in the shape of a mushroom, making a peculiarly painful and deadly wound. They are not countenanced by the powers openly.

The various machine guns and rapid-fire guns discharge twelve to 1,500 shots a minute, according to their size and mechanism. Some of these are wholly automatic. The Maxim gun, for instance, is so arranged that after each recoil of a previous discharge the shock opens the breech, extracts the empty shell, takes a fresh cartridge, cocks the gun, pushes the shell into chamber and fires the gun. The cartrid are loaded into the gun in a belt, and all operator has to do is to pull the trigger first time and the belt is ground thro the machinery at the rate of 600 shot minute. With such explosives, project and weapons in use it is apparent that w fare is becoming a more dangerous purs all the time. The following table shows armed strength of the great powers:

Country.	Armies. Peace footing.	Armies. War footing.	Navie[s] Ships.	M[illegible]
Austria-Hungary	361,693	2.000,000	34	[illegible]
France	628,755	3.250,000	124	[illegible]
Germany	576,666	3,000,000	77	[illegible]
Great Britain	212,449	475,000	259	[illegible]
Italy	825,340	3.272,409	57	[illegible]
Japan	157,829	603,000	22	[illegible]
Russia	1,100,000	4,600,000	75	[illegible]
United States	100,000		62	[illegible]

THE GERMAN EMPEROR'S AMERICAN YACHT

The schooner yacht Meteor, which christened by Miss Alice Roosevelt, dau ter of the President, when it was launcl in New York on February 25th, 1902, the presence of Prince Henry of Germa is the first pleasure boat that was ever b for a European monarch in an Ameri shipyard. The vessel from stem to st was the product of American build American designers and American wo men. His Imperial Majesty, the Empe of Germany, desired that to be the case. order that he might feel that he posses a genuine American product. It was n however, the first American pleasure b owned by Wilhelm II., who already p sessed an American-built schooner, Yampa, which he had bought some years fore from its owner, who was cruising German waters. When he ordered the teor he commissioned the designers of

Yampa to build a larger schooner, with such additional improvements as have been made in the last fifteen years. Only a few months ago the materials out of which this famous little international pleasure craft was built were scattered all over the United States, from the Atlantic to the Pacific. Polished masts of white pine were growing wild in their native Oregon forests. The iron and steel in the beams and plates were unmined ore in the Pennsylvania hills. The hardwoods for the finishing of the interior were hewn by American hands in American forests; the interior appointments, the plumbing and the fittings were made by American workmen, the sails were made by American sail-makers from American canvas, and the rigging was all the work of our own countrymen. It was natural and appropriate that it should be christened by a genuine American girl, to gracefully emphasize the national character of the whole performance.

The Meteor is a large yacht, having a length over all of 160 feet, a water-line length of 120 feet, a beam of twenty-seven feet and a draught of seventeen feet. There is thus deck-room enough for a court reception. Accommodation is furnished for a crew of at least thirty men. There are two saloons, the main and the ladies' cabin, and three large staterooms, in addition to the Emperor's spacious suite. In size, indeed. the Meteor is the largest schooner-yacht ever put forth from an American shipyard. The quarters are ample, though without ostentation. The comfort of the voyagers was the point chiefly aimed at. Altogether it is a handsome craft, quite good enough for an Emperor or an American. Its cost was about $150,000.

THE SECOND AND GREATER BROOKLYN BRIDGE

The Brooklyn Bridge is a name that has been known the world over for many a year as that of one of the most noteworthy achievements of modern times. A suspension bridge spanning the great East River and bearing the traffic of two great cities, it was indeed worthy of its high fame. But a time is coming now when the original Brooklyn Bridge will have to take a second place and be distinguished by a more specific name, for another Brooklyn Bridge is under construction that surpasses it in every way. The new bridge likewise spans the East River, connecting New York City on Manhattan Island with Brooklyn on Long Island. It is about a mile above the old bridge, and consequently will draw the great traffic from the shopping district of New York that until this time has been compelled to patronize the ferries.

The two steel towers from which the great roadway of the bridge is suspended are 1,600 feet apart, or nearly one-third of a mile. They rise to a height of 335 feet above the water, and the bridge itself is so high above the river that the masts of the largest boat may pass under it. From the tops of these great towers four steel cables, each as large as a man's body, carry a two-story platform twice as wide as a city street, with six railroad tracks, two carriage ways, two promenades and two bicycle paths. In order to attain the height over the river required for navigation, the tracks have to be carried over more than half a mile of streets and houses at each end of the bridge. The weight of the 1,600-foot span between the towers is 16,000,000 pounds, and it will carry with safety a moving load of 9,000,-

000 pounds. The steel in each tower weighs 6,000,000 pounds. The total cost of the bridge and its approaches is about $9,000,000, and of the land about $10,000,000 more. These figures are sufficiently eloquent to speak for themselves, and this greatest of American bridges is indeed a triumph of the builders.

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HOW MAPS AND GLOBES ARE MADE

Now that the relations of the different countries of the world have become so intimate and news is transmitted so rapidly and regularly by means of the electric telegraph, and distributed by the morning paper, it has become essential to have at hand for ready reference maps of all the world, in order to understand intelligently the things that are happening.

Chicago is the map making center of the country. It is said that more maps are sent out of that city annually than from all the other cities of the United States combined. Most of the railroads obtain their maps from Chicago. Hundreds of thousands of school maps are thrown off Chicago presses, and the majority of bicyclists who are ranging the country carry in their pockets Chicago-published maps made specially for them. Maps from the cheapest to the most expensive are made here, and whether cheap or expensive they follow the same path from the first drawing to the last time of going through the press. The difference comes in the size and the accuracy and care in the making which distinguishes them.

When the map publisher makes up his mind to publish a new map, one of Illinois, for instance, he orders the draughtsmen to make an original drawing. While any mechanical or architectural draughtsman can draw a map, the number who are regarded as expert map draughtsmen is small. The draughtsman takes the map of Illinois published last, and begins his work by copying it on the scale required. That is, he copies it larger or smaller according to the number of miles that each inch on the new map will represent. A map of Illinois six feet long by four feet wide would be made on a scale of six to one; that is to say, each inch on the map would represent six miles of distance.

But the new map must be "up to date," for Americans insist that their maps must show the very latest changes in boundaries, railroads, rivers, size and importance of towns and cities, and modifications of lake shores and seacoasts. Before the draughtsman begins his work the publisher has collected from government surveys, railroad time tables, railroad maps, and county and township surveyors all the information he can find regarding changes. With this information before him the map-maker begins his work. If any dispute or uncertainty arises over any particular section, a tracing is made of the territory under dispute, and this is sent to the official surveyor of that district for correction or approval. The drawing made in india ink is of the size that the map is to be made. All the lettering is put in with the pen, but merely to indicate the place where the type must print the names of the counties, towns, etc. When the drawing is completed it is taken to the engraving-room and turned over to the map engraver.

The engraver first takes a smooth-faced copper plate of the required size, and black ens the face by holding it over a smoking lamp, or by painting it with lamp-black, and then covers it with a composition made of wax and gum, laying on the composition to the thickness of light blotting paper. To get the composition even, the copper plate is slightly heated, for the composition melts easily. When the plate is thus coated it is ready to receive a transfer of the drawing. The back of the paper on which the map is drawn is covered lightly with black, brown or blue chalk, and this chalked surface is laid upon the wax composition which covers the copper plate. Then the engraver, with a fine steel pencil or stylus, goes over every line and mark in the drawing. As the steel point moves over the paper the drawing is copied on the composition, just as a copy of a drawing is made with black carbon paper. The composition is white and the chalk lines stand out conspicuously.

The plate is now ready for the graver, or V-shaped tool used by the engraver. With it he goes over the chalk lines, cutting out the wax composition to the copper plate. As he first coated the plate with lamp black, he can readily see his work, because the graver leaves a black line wherever it touches the copper. The engraver does not cut out the letters. He has an easier and better way; for, setting the names up in type, he places the type in a holder somewhat like a bookbinder's stamp, and then heating the type slightly, presses them into the wax to the copper. The holder is so arranged that the type can be set up either in a curved or straight line. Perhaps there is nothing on a map which excites more curiosity and draws out more guesses than the names of the towns and cities which straddle railroad lines, curve around rivers, and appear in a badly mixed-up condition. Every one knows that the names are printed by type, but how the type came there is a deep mystery to most persons.

When an exact copy of the drawing, with the names marked in type, is made on the plate, the engraver proceeds to "build up" the engraving. He takes a piece of the wax composition about the size and form of a lead pencil, and with a heated iron tool which looks like a piece of darning needle stuck into a handle, he builds up little mounds of wax on each side of the lines and letters. He does this to obtain the "relief," for all the time he has really been making molds in which to cast a copper electrotype. To pour melted copper into this mold would melt the wax instantly, so the map-maker turns to electricity as the agent which will deposit the copper in his wax mold. He suspends the engraved plate or mold in a bath, after first coating the mold with graphite. Not far from it hangs a pure copper plate. To each plate he connects a wire leading from a small dynamo. The current passing from the pure copper plate to the mold, through the liquid, carries with it the copper, which is deposited in the mold, thus really making a copper cast of it. When enough copper has been deposited, the mold is taken off, the copper cast removed, and the reverse of the drawing standing out in bold relief is taken off. This thin shell is backed up with metal to make it solid and strong, and it is then ready to be placed in the press to print thousands of maps of Illinois. To engrave a map about 11 inches wide by 14 inches long requires six weeks' work of the engraver.

The electrotype thus made is used to print the black map. For every color used in the maps, a separate plate must be made.

This explains why the price of a map increases in proportion to the number of colors used. The largest map made in one piece in Chicago is 66 inches long and 46 inches wide. Anything larger than that is made in sections, and the sections are neatly pieced together to make the whole.

Most of the maps made by or for the government are not made by the relief process, but are engraved on steel, copper, or stone. In engraving a map on steel, the steel plate is first coated with a peculiar varnish, which is acid proof. A transfer of the drawing is made on the varnish, but unlike the transfer made on the wax composition in the relief process, the copy is reversed. The engraver cuts through the varnish with his graver, and then the steel plate is placed in a bath of acid, which attacks the steel where it is not protected by the varnish. When the engraving is finished the maps are printed by the usual method of printing steel engravings.

For maps where extreme accuracy is required, as in coast surveys, soundings, and navigators' charts, a sheet of thin, transparent gelatine is placed over the drawing. With a sharp steel pencil the engraver copies the drawing into the gelatine. He then dusts blue powder over the gelatine, and the powder remains in the scratches or etching made by the steel pencil. By pressing this into the varnish the copy, in reverse, is transferred in clean, sharp lines. Engraving on copper or stone is done in much the same manner, and maps made from the stone are simply lithographed. The engraving is first made in the stone, after a copy of the drawing has been transferred to it, and then a transfer is made from the engraving to a flat stone by the lithographic process. The largest map printed from stone is 36 inches by 62 inches. For large wall maps the sections, which pasted together on cloth make the whole, are 48 inches by 42 inches.

What was said to be the largest map ever printed was exhibited at the World's Fair. It was the map of the United States, 14½ by 19½ feet in size. Each inch on the map represented eighteen miles. Near it stood the electrotype from which the map was printed. Its area covered nearly 300 square feet. It was made up of pieces so cleverly joined that the joints could not be detected.

The making of globes requires time, skill and patience. In high-class globes the sphere appears to be covered with a single piece of paper. As a matter of fact the globe is covered with twenty-four pieces, except in small globes, where half as many pieces are pasted on. The lines representing latitude on a globe appear to be straight lines. But with the exception of the equator, all the lines are curved, the curves being of such radius that when the pieces are pasted on the sphere the lines ar straight.

In one map publisher's engraving-roo in Chicago an engraver worked two and half years engraving the plates for eighteen-inch globe. He first secured a fect sphere eighteen inches in diam This sphere was tested in various way til the engraver was certain it was a sphere. Then he divided it into t sections on the line of the equator, ar it out on flat paper. Each section was shaped, curving evenly from point t When he cut it and pasted it on hi it wrinkled, and did not lie snugl bulge of the globe. He had to ex for a time until he secured th shape, width and curve for his sections, and then he laid out his map accordingly. As eight colors were to be used in printing the globe map, it required fifty-six plates before the globe could be covered.

The globes themselves are made of papier-mache. On this a coat of plaster of paris is laid, and this is turned true in a lathe. This process is used in Chicago in making all high-class globes. The greatest care must be exercised in making the globe maps, for the paper shrinks, and this shrinkage, if too pronounced, would ruin the globe. The paper is always run through the press one way. That is, the sheets are fed in exactly as they lay in the roll of paper when it came from the paper-mill. In this way the fiber of the paper always runs in the same direction in going through the press.

The largest globe made for sale is 30 inches in diameter. Until recently but few globes were made in the United States. To-day thousands of them are made and sold in Chicago alone. An 18-inch globe is now sold for about $35; ten years ago the price of an 8-inch globe was the same as that of an 18-inch globe to-day. The cause of this great reduction in price is found in the constantly increasing demand for globes, for 100 high-grade globes are now sold to one sold ten years ago.

WATCHES AND CLOCKS

The sixteenth century inventor of the watch or spring clock would have deemed it a dream if to his Swiss soul had come a vision of the great watch factories of to-day, their thousands of employes, the division of labor, and the enormous output. Indeed, those Swiss manufacturers who until recent years enjoyed a monopoly of the making of fine watches, can hardly realize now the extent of the industry in this country.

Those watchmaker shops of bygone days, where one or two men constructed an entire time piece, have given way to great factories where hundreds and even thousands of employes earn their daily bread. The dingy work shop has been supplanted by great factory buildings with a thousand distinct departments, well lighted and well ventilated rooms, and a complicated system centering about the superintendent's supply room, to which all parts are taken when completed, and about the factory office, which sells watches not only at home but also to the natives of Africa, to the Australian sheepmen, in short, to the inhabitants of the uttermost parts of the earth. The simple hand tools have given place to hundreds of machines, propelled by one central engine under one guiding hand.

American watches now form a great bulk of the world's entire watch production. Illinois is the seat of two of the greatest factories in the country, one at Springfield and the other at Elgin. Massachusetts has the great Waltham factory, and the work of watch making has been taken up in Ohio.

The modern watch is marvelously complex, yet marvelously simple. Its construction is merely the perfect union of a multitude of simple details. First it is necessary to separate the watch into case and works, for in spite of a popular idea to the contrary, they have no dependence upon each other. Watch works or "movements" in most American factories are manufactured in sizes ranging from number four, which is about the size of a half dollar, to number eighteen, which is fully twice as large. Cases are made corresponding to each of these sizes, and the sizes and the cases are adapted to any make of watch. They are the product of factories established for that purpose and, of course, are of endless variety.

The movements are constructed after various plans, but in most makes they have for their foundation two plates, the lower and heavier one called the pillar plate, and the upper plate, which is often in several sections. Between these two the mechanism of the watch is arranged. The lower plate generally is of brass, the upper of nickle. They are punched from strips of sheet metal to exactly the right size and shape, after which they are smoothed and polished.

To allow room for the little wheels, indentations absolutely exact are made in the foundation plates. This work is done by a wonderful machine which follows the outlines of a steel model, made for a pattern, with absolute mechanical accuracy. The thickness of the plate and the depth of the indentations are measured so as to be perfect, according to a gauge two degrees of which equal a thousandth part of an inch. Into the plate then are drilled the necessary screw holes and apertures for the jewel settings. For every step in the process of preparing the plates there is a new smoothing and polishing given them, so that all rough edges are continually removed.

Watches containing from four to twenty-two jewels are made in most factories. The jewels used are garnets, rubies, sapphires and diamonds. Garnets are the ordinary jewels and a fifteen-jewel watch is considered the standard. The garnets are imported from Coventry, England, and come in packages containing from 500 to 5,000 pairs.

The various wheels of a watch are stamped out of sheets of brass, with the exception of one or two pieces. The springs are made from sheet steel, and the screws of cold steel drawn from wire. The tempering of these various steel pieces is one of the classes of work in factories demanding highest order of skill. In tempering some varieties of screws, and some of them are so small that a glass is necessary to distinguish them from specks, the workman uses a thermometer of a peculiar sort in order that he may watch the temperature to which they are heated and then cooled at the exact point. Other varieties are tempered by watching their colors. They are heated over small furnaces until they give off light of the proper kind, and then are cooled. Screws in a watch of ordinary grade number about forty varieties, all of which are turned, sawed and gauged by girls in the factory.

The pinions, wheels, axles and similar pieces are turned out by girls. One machine cuts the pinion's length from a wire, turns it with three successive cuttings by tools which succeed one another automatically, and deposits the pinion. One girl seated on a stool which moves on rollers on a track can attend to five of these machines at once. The balance wheel, which flits back and forth with such never-varying regularity, requires forty different steps in its manufacture, simple as it appears. Steel and brass disks are brazed together, and are ground down to the required thickness. The united disk is then punched into a rim which is calculated to contain two parts of brass and one of steel.

In the edge of the rim, twenty-six holes are made, and the same number of small screws are inserted to preserve the balance of the wheel.

After the foundation plate receives its jewels and is polished, engraved and stamped with whatever ornamental design it requires, and has passed inspection together with the parts which have been adjusted to it, the whole is brought to the assembling room, where all the work of the factory comes to a successful termination. Each part has been rendered perfect. The works are adjusted, piece by piece, by fine divisions of labor, passing from hand to hand down a long row of workmen's tables in the process. Each man has his particular work and is responsible for it. When once assembled, the mechanism is tested as a whole. Thence it is taken to a refrigerator and subjected to cold. A stay in a hot-air compartment follows this, the temperature of the two tests ranging from forty degrees below zero to 103 degrees above. Not until it passes these tests without being affected is the watch considered to be perfect and ready for the market.

The dial of the watch is made by a complicated process in which a metal plate is coated with enamel, fired and glazed like china, and painted mechanically with the figures and designs before a second firing.

From the intricate details of watch manufacture it is necessary that the factory system be perfect and this necessity is met in most American factories. As a general thing the employes are comparatively well paid. The work is so specialized, however, that none of the employes become watch makers in the real sense of the word, but only skilled in their particular department. Each piece in the mechanism and each step in the process of manufacture is governed by fixed designs and made largely by automatic machinery, so that often an unskilled, inexperienced girl guides the machine which turns out work the most essentially exact.

The United States contains the largest clock factories of the world as well, and clocks made in this country are sold everywhere, their reputation being so high that the German and Japanese imitations, made in large numbers of late years, have actually adopted the designs and the labels of the American manufacturers, in order to obtain a share of the trade by deceiving the customer. The common spring-clocks might be called larger and rougher watches, and the processes of stamping out foundation-plates, wheels, springs and screws are not unlike those of the watch factory, modified to meet the conditions of the larger mechanism. The amazing cheapness with which watches and clocks are made, while their qualities of accuracy are preserved, is, of course, due entirely to the employment of automatic machinery which produces them in great numbers at the least cost. There is another advantage also in the fact that in machine-made pieces all the parts made by a given pattern are interchangeable, so that in the event of an accident, repairs can be made with the greatest ease and at the least expense.

Watch cases are hardly as complicated as are the works, but the factories making them are great institutions with most ingenious machinery in use. Thin sheets of metal are passed through machines which stamp out the disks of the right size, much as coins are stamped out in the mint. The disks are then passed through processes which form them to the right shape. The polishing and engraving are done by machinery, except when some special design is made to order. The filled cases which have become such a popular substitute for the more expensive cases of solid gold, are made by welding two thin sheets of gold on opposite sides of a sheet of steel, and then stamping the disks for the case out of this combination metallic plate. A case of great strength is thus obtained at moderate cost, with a surface of gold which will wear many years without deterioration.

MIRRORS AND THEIR MANUFACTURE

In the days when society and clothing were little appreciated, some heated man, in stooping to drink from a shady forest pool, saw a face in the water. After the first superstitious fear had been overcome he doubtless came again and again, each time with greater curiosity. Perhaps he also called the attention of his wife and daughters to the phenomenon, and as soon as they discovered that their own faces looked up at them from the water, doubtless they began to think of rings for their noses. Thus vanity was born when the mirror was discovered.

Since that time mechanical skill has been engaged in making portable substitutes for the shady pool, according to the model which nature provided. First the mirror was a polished piece of metal, usually bronze, and then it was silver or brass. Everywhere the early society belle went, she carried her mirror along with her in a little box which hung from her girdle. In some cases a slave was specially employed to keep it so highly polished that the reflection would be perfect. This use of metals continued until a comparatively recent time, and then some man who could not afford a piece of silver to look into devised a glass mirror. He found that the amount of metal required to make a thin coating on the glass was exceedingly small, and that its bright surface, being hermetically sealed by the presence of the covering glass, did not require any polishing. From that time to the present the glass mirror has prevailed, and the process of manufacturing has varied only in small details.

In the first place a mirror requires the finest kind of glass, without spot or speck or "blow-holes." The best work is done with the plate glass manufactured in St. Gobain, France, and in numerous cities of Belgium. All the largest manufacturers of mirrors use the foreign varieties in preference to those of American manufacture. The glass comes in huge plates, a quarter of an inch thick, ten or fifteen feet long, and half as broad. As many as a dozen plates are packed in a single box, displaying numerous warnings to "handle with care." When the glass is taken out it is covered with dust and bits of excelsior, and the first thing that is done is to wash it clean with water. Then a dozen of men who know just how to handle a great piece of glass without subjecting any portion of it to a breaking strain carry it into the cutting room. Here a workman in a long leather apron—usually a Frenchman who has had great experience in foreign mirror manufactories—blocks out an order on the plate, say two or three beveled mirrors for some lady's boudoir. A diamond-pointed instrument, with a strong and steady hand behind it, traces the lines of drawings on the glass and cuts a groove so deep that the pieces easily crack out.

Each of these oval pieces is then borne into another room, filled with the humming noises of rapidly-moving machinery. A thin-faced foreign workman, with his sleeves rolled up to the elbows, and a ragged apron draping him from chin to toes, picks it up and places its edge upon the side of a swiftly revolving iron wheel. From a large wooden tank, which strongly resembles a New England ash-leach, a steady stream of sand and water flows upon the iron wheel, and in passing between it and the edge of the glass wears the bevel. The muddy water from the wheel is frequently thrown off in the swift revolutions, and works polka-dot designs all over the operator. But he is a skilled workman, and in his pride in getting the bevel on the glass exactly even—and he must depend wholly on his eye—he doesn't pay any attention to the flying mud.

When the bevel is complete it resembles "mist" or ground glass, and is full of scratches and rough places. The next workman in order smooths the bevel on a rapidly revolving emery wheel, which casts off a perfect shower of sparks. When it is as smooth as it can be made by this process it is passed to a third workman, who applies it to a fine grindstone from Newcastle, and in two minutes almost all traces of roughness have been removed. A small boy sits above the next wheel, which is made of wood, and daubs it with a wisp broom which he dips continually into a tub of water standing near at hand. He and the operator are both covered with the thin gray fluid which the wheel throws off.

By the time the wooden wheel has been used, the bevel, to the ordinary eye, looks as smooth as the other parts of the glass. But to the trained eye of the master-workman, who has watched for flaws in the glass since he was a child, it is far from perfect, and he takes it in his hand and passes the bevel swiftly over a wheel, which is smeared with ordinary rouge, such as the actress uses to make blushes on her cheeks. It may be imagined that this part of the shop has been well treated with red—the men are all red, the floor is red, the tools are red and in passing through the department the visitor frequently acquires involuntary blushes. When the embryo mirror has passed the rouge wheel its bevel is perfect, and it is sent to an expert for inspection. If there are any remaining scratches on the glass they are marked with chalk, and a workman with an old rag smeared with rouge rubs away until it is smooth and fine.

The glass is now ready for the silvering room—a tight, hot, well-lighted apartment in which the workmen wear as little clothing as possible. An inclined plane of boards, which resembles a huge washboard turned on its side, fills one corner of the room, and on this the plates of glass are laid face downward. Over them the workman spouts a stream of water, which cleans off the dirt. Then with another hose he plays on the glass with a sensitizing solution of tin, the exact composition of which is a trade secret. The pieces of glass are next gathered up by a workman and are borne to the "bed."

While it is not provided with pillows, the "bed" is complete in almost every other particular. It has a blanket which is strung across a frame about the size of an ordinary bed, and over this a cotton sheet is stretched. Underneath, so that its surface just touches the blanket, there is a large vat of water kept hot by steam pipes. The embryo mirrors are laid on the bed face down, and while they are yet wet with the sensitizing solution, a workman pours a diluted compound of nitrate of silver, ammonia and tartaric acid over each glass. The exact composition of this solution is also a trade secret, each firm having its own methods for mixing and each is certain that it cannot be beaten in results.

Assisted by the heat from below and by the tin solution, the silver is quickly precipitated on the glass. When the workman in charge thinks the coating is thick enough he pours off the surplus of the silver solution, and the mirror—for it is no longer in an embryo state—is put into a warm "bed" to dry off. Here another workman takes the mirror and paints the back of it with a protective solution. Each firm has a different color of paint and each paint is usually a composition differing from all the others, so that when a mirror is received for resilvering the manufacturer can usually tell just what firm originally sent it out. Frequently in special orders the backs of mirrors are covered with felt.

The whole process in the silvering-room is wasteful of silver, and many devices have been used to preserve all the metal possible. The blankets of the beds and the coverings of the tables where the nitrate of silver crystals are ground up, all go to the refineries for burning, and about 20 per cent of the silver is recovered.

The whole process of making a beveled mirror does not take to exceed an hour by the present methods, and no stage is dangerous to the workmen. When mercury and tin-foil were used a number of years ago, the fumes killed many of the operatives and a mirror could not be completed under ten days.

A large mirror is much more difficult to make than a small one, owing to the difficulty of handling the somewhat fragile glass. The largest mirror ever made in Chicago—so say the manufacturers—was 18½ feet long and 8 feet broad, and it was used in a liquor saloon. Two or three of the five large manufacturers of mirrors in Chicago use French glass almost entirely, for the reason, they say, that it is much finer in quality, and lacks the greenish tint which spoils American glass for the best trade. Chicago not only supplies the home market with mirrors but ships them all over the West and to Mexico, Canada and South America.

Making plain mirrors adds about 20 per cent to the value of the plate glass, or in beveled work 30 per cent. For instance, a piece of plain French plate glass, 5x10 feet, would cost about $75. A plain mirror of the same size would sell for $90.

ART WORK IN BRASS

Ornamental brass work has become an important industry since banks and other business offices have taken to plate glass, mosaic floors, statuary, stained glass over desks, and other decorative luxuries. This style of brass work is but the refinement of a commoner art, and the same men who make car-fittings, valves and brass work for steam engines and other machinery, can step into an "art brass" foundry and turn out high-grade work. The brass is cast in the foundry, cleaned, pickled, buffed, spun, turned, brazed, lacquered and polished in one shop as well as in another; the difference is that finer material, daintier designs and forms and a higher finish are used in ornamental work.

The foundry is the beginning. There the brass is roughly cast to form, and from thence it starts on its way to the finishing bench. Here the alloy of copper and tin, or copper and other metals which make brass, is cast in molding sand. The operation is similar to that used in an iron foundry, particularly in an iron foundry which makes a specialty of light castings—or, as the molders call it, "snap flash" work. The brass molders work at benches—or, rather, troughs—in which is kept the molding-sand, which looks like rich black dirt and is so cohesive that when pinched between the thumb and finger the sand holds together and shows the mark of the pinch. The flask in which the sand is packed around the pattern is made of two frames, one fitting over the other. One frame has legs of wood, called dowels, and the other has holes in which these dowels fit, so that when the frames are brought together, one will remain over the other. The frames are made of four pieces of wood, fitted up with hinge-like corner-pieces, so that the frame can be unlocked and taken away from the sand without disturbing it.

The molder lays one of the frames on a smooth board which goes from one side of his bench to the other, and fills it with sand. In the center and on top of the sand he lays the pattern, and presses it into the sand, and then fits the other frame over it. He shakes over the pattern some fine "parting" sand, and then fills the upper frame with molding sand, ramming it down hard with a couple of hard wood rammers, shaped something like dumb-bells, except that the ball on one end has a flat surface, and on the other tapers to a blunt, chisel-shaped point. After the sand is well pounded around the pattern, the molder scrapes the surplus sand from the top frame with a stick, and runs a pointed wire into the sand toward the pattern, thus providing escapes for the gases which form when the molten metal is poured in. Then he turns over both frames, or the flask, and carefully lifts the bottom frame—now the top one—from the other, exposing the pattern imbedded in the sand. The pattern is withdrawn by driving a steel pin into the wood, or, if it is a white-metal pattern, by means of a screw pin made for the purpose, and the operation is aided by gently tapping the pattern as it leaves the sand.

For hollow castings the cores are now put in place. A core is made of sand, paste and sometimes sour beer, rammed into molds and afterward baked in a large sheet-iron oven over a coke fire. Coremaking is generally done by boys, with perhaps two or three men for making the intricate cores. When the cores are laid in place in the hollow space left by the pattern, the molder scoops out his "gates," or channels, through which the melted brass will find the mold, and then, placing the frames together, he takes off the woodwork and lays on the floor the short board with the block of sand on it. This is the way straight and core work is done. But for some purposes false core work is required, and this is, in miniature, what is done in making the mold for casting large bronze statues.

Some patterns have undercuts which cannot be molded in sand as plain patterns are. They are made with false cores, and this work requires the greatest skill in the foundry department. An ordinary core gives form to the hollows of a casting, or makes the holes through a casting. A false core is a part of the mold built up separate from the mold proper, and as it is in small pieces it can be taken out without removing the pattern. Thus a bust can be buried in the sand, but its irregular form, its deep cuts and incurving depressions make it impossible to withdraw it from the sand without bringing part of the mold with it. The brass-molder gets around this by building up the mold out of sand packed so tight and hammered so close into the different parts of the pattern that each part can be taken away, and when the pattern is removed can be properly assembled again to form the mold. Sometimes a dozen or more pieces are required to build up a false core.

The brass is melted in crucibles, and the furnaces, usually below the floor level, are in a line, so that all the melting is done in one part of the foundry. With a pair of large tongs the crucible is lifted out of the bed and carried to the molds, and the metal is poured into the gate and thus fills the hollow in the sand. The castings which are to be polished are cleaned in water and "pickle"—acid and water—and are then buffed or burnished. Sometimes they are finished by being dipped in strong or weak solutions of nitric acid and water. For "bright dipping" the acid is strong and the brass casting is instantly withdrawn from the bath, but when a dead finish is desired the acid solution is weaker and the casting is left in until a creaming color appears on the surface. In burnishing, the brass is brought to a high finish by being rubbed with polished steel tools, or it is held against buffing wheels, which are thick, soft wheels made of cotton. Rouge, a red polishing mixture, is put on the wheel and the high speed of the wheel polishes the brass. The buffing wheel cannot be used, however, on rough castings or irregular surfaces. The brilliancy and polish of brass which has been burnished or buffed is heightened and preserved by lacquer. This is put on the polished brass by girls, and the lacquer is dried in an oven.

Brass is spun, stamped, pressed and drawn in the same manner as copper, gold and silver, and many of the trade secrets of goldsmiths and silversmiths are shared by brassworkers.

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BELLS AND HOW THEY ARE MADE

Ever since the beginning of civilization men have been called to worship by the ringing of bells. As the strand of scarlet runs through all the ropes and hawsers belonging to England's navy, so bells have marked the history of religion. Whenever the Jesuits of old established a mission, a bell was thought almost as important as a priest, and it was often brought from the foundries of Europe at great labor and ex pense. To many a heathen mind th clangor from the chapel belfry must ha been almost synonymous with the wh man's God. Even to-day, as soon as a lit pine church sprouts up on a village h side, and before the gloom of the mortg which hangs over it has been dispelled, "ladies' aid society" and the "young f helping hand" begin to raise money bell.

But Christians are not the only devotees. The Chinese and Japane among the greatest bellmakers of the and they have worked to the glory of Buddha or Confucius. In some ways bells have grown to be more or less a symbol of religious ceremonials.

Whether from these associations or from the fact that early castings were attended with much church ceremonial, the making of bells has something impressive about it. The manufactories are usually great, gloomy, smoky buildings, with no floor but the earth. One end is filled with the bell molds, and not farther away than the arm of a giant crane will stretch, stands the furnace in which the metal is melted.

The whole process has been reduced to a marvelously exact science. Knowing one dimension and the tone of a bell, an expert can figure out all the other measurements and the weight. In fact, the main part of bell-making is done in a clean little room where a man sits busily at work soiling clean paper with figures and drawings.

For instance, the thickness of a bell's edge is one-fifteenth of its diameter, and its height is twelve times its thickness. It must also be constructed of just the right thickness in its various parts, so that when tapped on the curve of the top it will yield a note one octave above its real key note; when tapped one-quarter of the distance from the top it will yield a note which is one-fifth of an octave, and when tapped five-eighths of the distance from the top it will yield one-third of an octave. Where the clapper strikes, all of these three will sound simultaneously, thus yielding the consonant or key note of the bell.

These are exact rules, and they have to be carefully reduced to dimensions. Besides this, the proportions of the metal to the size of the bell must be calculated. Copper and tin are used for large bells, but the mixture varies widely, and almost every manufacturer has a rule of his own. About four parts of copper are ordinarily used with each part of tin.

When the designs have been made for a bell they go to the pattern-maker, whose haunt in his little workshop at one side of the foundry is a veritable museum of tools and patterns. The workman, after carefully making the measurements on a spruce plank, cuts out two long strips of wood, one of them just the contour of the inside of the projected bell, and the other the contour of the outside. This work must be very careful and exact. By the time it is completed the leather-aproned men at the other end of the foundry have made the basin for the mold. It is constructed in the earth, and consists mainly of firebrick and clay. At its center a stout post is planted, perfectly plumb, and just the height of the proposed bell. The two contour pieces from the pattern room are now pivoted to the post in such a way that they will swing around like the free leg of a compass.

In the center of the basin and around the post the workmen build a little furnace of brick, so large that it almost reaches the sweep of the inside contour leg of the compass. It is then pieced out on top with fireclay, until it exactly conforms to the sweep of the contour leg. After having been made very smooth the little furnace, which is just the size of the inside of the bell, is allowed to harden for a time. This is the core. Then grease is applied and workmen again plaster on the clay until it reaches and is swept smooth by the upper contour leg. This covering of clay is exactly the size and shape of the projected bell. Any designs or inscriptions are now worked in reverse order on the "sham-bell" and plugged "maiden state," as it is called, the bell is tested, and if it gives out a single pure tone it is regarded as a perfect cast. The manufactory which can turn out the largest proportion of "maiden" bells is the most successful. If the tone is not pure the bell can sometimes be tuned by filing away the parts of the inside surface, but it can never be made equal to a "maiden."

The largest bell ever cast was the celebrated "king of bells," as it is called by the Russians, in Moscow. It was made under the orders of the Empress Anne in 1733, and at the time of its casting a great religious ceremony was held, during which hundreds of nobles threw their silver and gold jewelry into the furnace. The bell measures 22 feet 8 inches across the mouth, 19 feet 3 inches in height and its thickness at the base, where the clapper would strike, is 23 inches. Its estimated weight is from 400,000 to 440,000 pounds. A nearly triangular piece of metal about 6 feet high and 7 feet across the base, weighing 11 tons, is broken out from the rim. There has been much discussion as to whether it was ever rung or not. Be that as it may, the bell now stands within the Kremlin, where it was originally placed, to serve as a chapel for religious exercises. Its value on account of the gold and silver which it contains is said to be very great.

The largest bell in America is in the cathedral of Montreal. Its weight is 28,000 pounds. The old "liberty bell," which rang when the Declaration of Independence was signed, weighs only 1,500 pounds. Early Chinese bells were nearly square, and were welded out of different pieces.

The Mexicans make bells out of clay, baked like pottery, in the form of women, arms, head and skirts.

HOW ARTESIAN WELLS ARE BORED

Artesian wells are changing some of the dry, arid tracts of the west into the best farming lands of the country. The water brought sometimes a thousand feet from under the surface, is conveyed, by irrigating ditches, to the parched earth, rich in all that goes with good producing soil except water, and when that great need has been supplied abundant crops will result. In large cities, equipped with extensive and modern waterworks systems, thousands of artesian wells supply industrial plants with water, and in the long run save thousands of dollars of water taxes to the manufacturers.

In some wells the pressure of water is sufficient to send it to the surface, but from the majority of wells the water is pumped by steam pumps or windmills. The man who bores an artesian well works under a great disadvantage, for he is in the dark as soon as his boring and driving tool is well under the surface of the ground. His drill points, casing, rods, sand pump, reamer or any one of the dozen tools and appliances he uses, may be broken hundreds of feet under ground, but he goes to work to extract the broken tool or dislodge the piece that is stuck as calmly as though it were just at hand.

The ingenious devices used by the well borer for repairing damage and overcoming obstacles, are the result of the hard, exasperating, practical, expensive experience of hundreds of well borers for many years. The business of boring artesian wells, drive wells, oil, gas and other wells made by sinking a line of pipe, has developed into a distinct branch of hydraulic engineering, for water is one of the most important tools used by the up-to-date well borer. In fact, some holes are literally pumped out, and the pipe casing sinks into the ground without a blow or a shove.

In driving a tube well on a farm either a horse-power machine or a portable steam engine is used as power. A hole is bored for some distance and this hole is cased with an iron pipe which is driven into it. The well-driving apparatus consists of a drill screwed to the bottom of the drill rod, which is in sections, so that the rod can be lengthened by screwing sections together.

The drill rods are made of iron pipe, and every thirty feet or so in the hollow drill rod is a valve which opens from beneath. In the drill is a hole, and as the drill is lifted and dropped alternately by the mechanism on the ground, water is poured into the well. This makes a "slush" of the pounded, crushed earth, clay, gravel or stone, and it enters the drill rod through the hole in the drill.

When the drill is lifted, of course the rods, with the water and slush in them, are raised. The drill is dropped suddenly, and as the heavy iron and steel falls more rapidly than the slush and water, the slush passes into the next section above through a valve, which closes when the drill is again raised. In this manner the drillings are lifted to the surface and are there discharged.

The drill is lifted and dropped, crushing its way deeper and deeper into the earth, and as it sinks the iron casing is driven down after it. A pump is always attached to the head of the apparatus, and when water is reached the pump is started, and the sand in the gravel bed is pumped out, forming a reservoir in the clean gravel. This method of sinking a well is rapid and inexpensive.

An improvement on this is the "rolling" and "jetting" process. This is a combination of the principles of hydraulic mining, as practiced in California, and of the diamond drill without the diamonds. In hydraulic mining a stream of water, forced from the nozzle at a great pressure, is directed against the bank, and the earth is washed away just as furrows are cut into the sod on a lawn by the jet of water from a garden hose.

A diamond drill cuts its way into the earth, clay and rock, by revolving a drill-point studded with black diamonds. In the rolling and jetting system used in sinking artesian wells, the cutter is a section of pipe on the lower end of which teeth are cut. As this is revolved in the ground by the machine which grips the pipe and turns it, jets of water are forced down inside of the pipe. The water rushes out from under the cutter's teeth and returns to the surface of the ground on the outside of the pipe. This returning water cushion between the pipe and the earth lessens the friction and gives the casing an easy rotation.

Naturally the hollow cutter carries a core of the material through which it forces its way, and the well-borer utilizes this core, if it be of clay, to build up a clay wall for the bore when it passes through quicksand. If there be not enough clay in the core for this purpose, he puts some in the pipe, and the water carries it down and up, packing it in the quicksand. If a material is met which the cutter finds difficulty in boring, broken emery rock, iron ore, flint sand and other abrasives are sent down through the pipe. For material too hard to be cut by the steel cutter, a cutter set with black diamonds is used. A modification of this hydraulic-cutting combination is a steel "paddy" drill, which is carried down with the casing and cutter. This apparatus permits the use of all the appliances without taking out or letting down other tools. A drill is attached to the end of a hollow drill rod which goes down inside of the casing. The rod and casing have independent movements, so that the drill can work ahead of the casing, or the casing can cut its way without the drill, both of them aided by the water sent down from above.

Enormous augers which bore holes from eight to thirty inches in diameter are used to sink shallow wells. It is conceded that wells more than 60 feet deep should be bored with the well-driving machinery and not with earth augers. The huge auger is fixed to the lower end of a vertical shaft, which is connected with the proper mechanism to twist it around. In the use of horse power the auger shaft is attached to the sweep to which the horse is hitched. Some of the augers are real augers, others are bucket-shaped, with cutting edges, and still others are claw-shaped, but they all cut out the hole, and when full of earth are lifted to the surface, emptied and sent down to corkscrew their way deeper.

Such wells are cased with vitrified, glazed or terracotta tiling, galvanized pipe, etc. If the auger, which is not made for stone work, meets a rock or a boulder, a drill is sent down the hole and the rock is broken or bored through. If it is a loose stone it is lifted from the hole, provided it is not too large for the bore, by "screw tongs," "ram's-horn" rock extractors and other devices of like nature.

A sand pump is a hollow cylinder of iron, fitted with a hinged bottom which opens inside of the cylinder. When it is dropped into the sand the door is forced up and the sand, when inside, holds it closed so that the material can be lifted out.

DISCOVERIES IN MEDICINE AND THE PROLONGATION OF LIFE

Dr. John Pot came to Virginia in 1610, and Dr. Samuel Fuller came over in the Mayflower in 1620. They have the distinction of being the first white "medicine men" within the present limits of the United States. An attentive schoolboy twelve years of age doubtless now knows as much of the genuine principles of health as they did, and he is a dull student if he does not know a great deal more of the structure of the body.

At the close of the Revolutionary War there were about 3,500 medical practitioners in the United States, and only about 400 of these had graduated from any school of medicine. There were then only two medical colleges in this country, and they had conferred only 51 degrees. So few people patronized the doctor that usually he made his living at some other work and practiced medicine as a pastime.

The theory and practice of medicine have since then advanced to a high position among the sciences by the aid of important discoveries made in kindred sciences. The sufferings of the human race have been decreased more than can be estimated, and the happiness of mankind has been advanced in proportion through medical investigation and prophylactic discoveries with their allied sciences. A few of the more important general discoveries may be thus mentioned:

Lady Mary Montagu brought the knowledge of inoculation against smallpox from Constantinople, and Dr. Jenner, in 1798, taking it up as a scientific matter, brought vaccination into general use. In Europe, previous to the introduction of this preventive, at frequent intervals, from one-fourth to one-half of the population of the great cities were attacked by smallpox and 95 *per cent of the* children under ten years of age died, while more than half of the others were left badly disfigured. In contrast, the greatest epidemic of smallpox in the nineteenth century, that of 1872 and 1873, attacked less than five per cent in any city. In Germany, where vaccination is rigidly required, the deaths from smallpox are less than one-tenth of those of the surrounding countries, where vaccination is not thoroughly done.

LABORATORY WORK IN A MEDICAL COLLEGE.

Auscultation, or listening to the sounds produced in the chest by the heart and lungs, as invented by Laennec in 1819, revolutionized the treatment of diseases of the internal organs of the body.

Dr. J. Y. Simpson of Connecticut made the greatest discovery of the nineteenth century in its application to surgery, by making practical the use of drugs to deaden pain. Anesthetics thus did away with the horrors of surgical operations on suffering human beings.

Chemical cleanliness from all destructive germs in surgical work is the result of the discoveries of Joseph Lister of England. It is estimated that through his discoveries in the use of antiseptics the death rate from infections of wounds has been decreased at least one-half.

The minor discoveries that alone would mark an epoch in almost any science, such as antitoxin, which has reduced the mortality from diphtheria fully 95 per cent, with the discoveries of Pasteur and Koch to avert hydrophobia and tuberculosis, are too numerous to mention except in an extended treatise on the subject.

APPLICATION OF THE LIGHT CURE IN A LONDON HOSPITAL.

SPECIAL CULTS AND CURES

Innumerable specifics have meanwhile become popular, to contribute to general practice whatever they contained of value, and then fall into disuse.

The food cure is an exclusive diet of milk, grapes, and farinaceous vegetables during any period of disturbance in health.

The earth cure consists in immersing the body in mud or dry earth during periods of soreness or pain.

The water cure is the use of water at different temperatures either in immersion, douches in solid streams, or by the body being packed in wet sheets. The steam or hot air baths are used in the same connection, with vigorous rubbing with coarse towels.

The air cure, for rheumatism, paralysis, and similar diseases, is also known as the vacuum treatment. It is given by manipulating the limbs or parts of the body under or with vacuum pumps or disks.

The oxygen or ozone cure requires the patient suffering debilitation or lung troubles to live in an atmosphere specially prepared for him in an air-tight room or by the use of special inhalers.

The cure from sun-air baths is applied by exposure of the skin to the direct rays of the sun in dry, still air.

Breathing methods require certain periods each day of deep chest expansion where the air, if possible, is dry and pure.

Cures by electricity are effected by keeping the diseased parts directly in a current of electricity as powerful as may not be painful, for a given time.

The movement cure is a mechanical assistance given to the vital forces known as voluntary and involuntary. It is claimed that a violent agitation of parts that are in a state of torpor arouses and stimulates the circulation through them, both of blood and nervous force. Machinery is used to give vibration, which is said to produce heat and consequent development of energy in the parts.

The lift cure is accomplished by the action of standing erect, knees bent three or four inches, upon a platform resting on spiral springs. The lifter grasps a cross bar connected with the springs, adjusted by weights. The operation is in straightening the bent knees, while otherwise remaining erect, thus lifting the weight, and breathing deeply and rhythmically with each movement.

Mind cures, faith cures, and the like, consist in mentally separating one's self from the disease and giving it no place in the system.

The rest cure is self-explanatory as to treatment. It consists of a complete cessation of mental and physical action for given periods under the most comfortable conditions, or as isolated as possible from all disturbance. The latter has been called the wilderness cure.

SYSTEMS OF MEDICAL TREATMENT

Hahnemann, when he invented Homeopathy, on the principle that like cures like, gave the name Allopathy to the earlier school that cured on the theory of revulsion, that is of substituting one disease for another, as practiced by Paracelsus; and he also gave the name Enantiopathy to the doctrine that a thing is destroyed by its contraries, as practiced by Galen.

Hydropathy was the name given later to the school which effected its cures by the various uses of water, as practiced by the Rosicrucians.

The Eclectic school, as the name suggests, claims to take the best from all systems, but it relied mainly in the beginning on decoctions and extracts of herbs.

Osteopathy has firmly established itself in many places, and depends for its cures on the manipulation of the bony structures of the body. There are numerous minor systems, but the great discoveries of the last few years have almost completely obliterated the former dividing lines of the older medical schools. Physicians, like other thinking men, are becoming more tolerant of varying opinions and methods. The best of them frankly admit that good is found in all schools of practice, and are glad to make use of whatever discoveries aid in the healing of bodily ills and infirmities. So the entire body of medical men, in the highest sense of the phrase are becoming eclectic. No longer do they refuse to consult with their rivals, and the public thus is permitted the benefits of all progress.

ELEMENTS OF PHYSICAL HEALTH

The assertion made for so many generations that cleanliness is next to godliness may not be as persuasive as if we were to say that cleanliness is the first law of health and long life. That many persons have attained extreme old age without regard to cleanliness is not very weighty proof that cleanliness is not one of the most goodly assistants to longevity.

OPERATING ROOM IN A GREAT DENTAL COLLEGE.

Since there are 2,800 outlets to the square inch all over the body, making a personal sewage system of twenty-eight miles of pipes, this effort of nature to get rid of its waste matter should be fully sustained by baths and clean clothing. Fifteen minutes is long enough for any bath, and the water should be warm, tepid or cold, according as the person may find it most enjoyable and beneficial. No absolute rule can apply to all persons and all conditions.

During fatigue and while the stomach is digesting food, there should be no disturbance of the temperature of the skin, nor should a bath be taken within an hour or two after a meal.

Nothing quickens the functions of the body in a more harmonious manner than suitable exercise. It should always stop short of fatigue, and never extend to violence. Exercise of a general nature equalizes the circulation and aids the assimilation of nutriment. It prevents congestions and torpor of all kinds. It is thus of animating service to the mind, and may be regarded as the most important element in the promotion of long life.

Sleep is rest, and rest is the necessary alternate in all energy. Comfort is the first condition of sleep, after the suspension of action and thought. Sleep is the most restorative when it is the most complete suspension of all energy within body and brain. By systematic practice one can thus compose the mind at will and the healthy person should be able to fall asleep within five minutes of the first attempt. Cessation of thought without sleep may even become complete enough to be complete cessation of image-making, and therefore a fully unobstructed rest.

One who has a natural appetite and a normal organism, should never swallow anything that is in any way distasteful, nor should he ever impose any labor upon digestion that should be performed by mastication.

Usually in any derangement of the system, and most derangements come from some torpidity in the digestive organs, the first effect is a disinclination toward food. This is nature's warning that the digestive apparatus is in no condition to do its work and the warning should be heeded.

The organs that take up the nutriment from the food can only use so much, and an excessive quantity of food only dulls their vitality. In times of famine those die of starvation first who have been the heaviest eaters. Those whose habit it has been to eat little can extract more nourishment from the food eaten than the others are able to do, and so suffer less.

THE PULSE IN HEALTH

The frequency of the pulse varies slightly according to temperaments, but the following is regarded as the average:

New born infants from	140	to	130
During first year, from	130	"	115
During second year, from	115	"	100
From seventh to fourteenth year, from	90	"	85
From fourteenth to twenty-first year, from	85	"	75
From twenty-first to sixtieth year, from	75	"	70
In old age, from	70	"	60

CONTAGIOUS AND ERUPTIVE DISEASES

It will often relieve a mother's anxiety to know how long after a child has bee exposed to a contagious disease there danger that the disease has been contracte The following table gives the *period of cubation* — or anxious period—and ot information concerning the more important diseases:

Disease.	Symptoms usually appear within.	Patient is Infectious.
Chicken-pox..	14 days	Until all scabs have fallen off.
Diphtheria....	2 "	14 days after disappearance of membrane.
Measles......	14 "	*Until scaling and cough have ceased.
Mumps.......	10-22 "	14 days from commencement.
Rötheln......	14 "	10-14 days from commencement.
Scarlet fever.	4 "	Until all scaling has ceased.
Small-pox....	12-17 "	Until all scabs have fallen off.
Typhoid fever	11 "	Until diarrhœa ceases
Whooping cough......	14 "	†Six weeks from beginning to whoop.

*In measles the patient is infectious three days before the eruption appears.

†In whooping-cough the patient is infectious during the primary cough which may be three weeks before the whooping begins.

FIRST AID TO THE INJURED—WHAT TO DO IN EMERGENCIES

Drowning. 1. Loosen clothing, if any. 2. Empty lungs of water by laying body on its stomach and lifting it by the middle so that the head hangs down. Jerk the body a few times. 3. Pull tongue forward, using handkerchief, or pin with string, if necessary. 4. Imitate motion of respiration by alternately compressing and expanding the lower ribs about twenty times a minute. Alternately raising and lowering the arms from the sides up above the head will stimulate the action of the lungs. Let it be done gently but persistently. 5. Apply warmth and friction to extremities. 6. By holding tongue forward, closing the nostrils and pressing the "Adam's apple" back (so as to close entrance to stomach), direct inflation can be tried. Take a deep breath and breathe it forcibly into the mouth of patient, compress the chest to expell the air and repeat the operation. 7. *Don't give up!* People have been saved after *hours* of patient, vigorous effort. 8. When breathing begins take patient into a warm bed, give warm drinks, or spirits in teaspoonfuls, fresh air and quiet.

Burns and Scalds. Cover with cooking soda and lay wet cloths over it. Whites of eggs and olive oil. Olive or linseed oil, plain, or mixed with chalk or whiting.

Lightning. Dash cold water over a person struck.

Sunstroke. Loosen clothing. Get patient into shade, and apply ice-cold water to head.

Mad Dog or Snake Bite. Tie cord tight above wound. Suck the wound and cauterize with caustic or white-hot iron at once, or cut out adjoining parts with a sharp knife.

Venomous Insects' Stings, etc. Apply weak ammonia, oil, salt water or iodine.

Fainting. Place flat on back; allow fresh air and sprinkle with water.

Tests of Death. Hold mirror to mouth. If living, moisture will gather. Push pin into flesh. If dead the hole will remain, if alive it will close up.

Cinders in the Eye. Roll soft paper up like a lamp lighter and wet the tip to remove, or use a medicine dropper to draw it out. Rub the other eye.

ANTIDOTES FOR POISONS

First. Send for a physician.

Second. Induce vomiting, by tickling throat with feather or finger. Drink hot water or strong mustard and water. Swallow sweet oil or whites of eggs.

Acids are antidote for alkalies, and vice versa.

SPECIAL POISONS AND ANTIDOTES

Acids, muriatic, oxalic, acetic, sulphuric (oil of vitriol), *nitric* (aqua-fortis). Soap-suds, magnesia, lime-water.

Prussic acid. Ammonia in water. Dash water in face.

Carbolic acid. Flour and water, mucilaginous drinks.

Alkalies. Such as potash, lye, hartshorn, ammonia. Vinegar or lemon juice in water.

Arsenic, rat poison, paris green. Milk, raw eggs, sweet oil, lime-water, flour and water.

Bug poison, lead, saltpetre, corrosive sublimate, sugar of lead, blue vitriol. Whites of eggs or milk in large doses.

Chloroform, chloral, ether. Dash cold water on head and chest. Artificial respiration. Piece of ice in rectum. No chemical antidote.

Carbonate of soda, copperas, cobalt. Soap-suds and mucilaginous drinks.

Iodine, antimony, tartar emetic. Starch and water. Astringent infusions. Strong tea, tannin.

Mercury and its salts. Whites of eggs, milk, mucilages.

Nitrate of silver, lunar caustic. Salt and water.

Opium, morphine, laudanum, paregoric, soothing powders, or syrups. Strong coffee, hot bath. Keep awake and moving at any cost.

Strychnine, tincture of nux vomica. Mustard and water, sulphate of zinc. Absolute quiet. Plug the ears.

RULES IN CASE OF FIRE

Crawl on the floor. The clearest air the lowest in the room. Cover head wit woolen wrap, wet if possible. Cut hol for the eyes. Don't get excited.

Ex-Chief Hugh Bonner, of the Ne York Fire Department, gives the followir rules applying to houses, flats, hotels, etc

Familiarize yourself with the location ‹ hall windows and natural escapes. Lear the location of exits to roofs of adjoinin buildings. Learn the position of all stai ways, particularly the top landing an scuttle to the roof. Should you hear a cr of "fire," and columns of smoke fill th rooms, above all *keep cool.* Keep the doo of rooms shut. Open windows from th top. Wet a towel, stuff it in the mouth breathe through it instead of nose, so as n to inhale smoke. Stand at window and g benefit of outside air. If room fills wit smoke keep close to floor and crawl along b the wall to the window.

Do not jump unless the blaze behin is scorching you. Do not even then if th firemen with scaling ladders are coming u the building or are near. Never go to th roof, unless as a last resort and you kno there is escape from it to adjoining buil ings. In big buildings fire always goes t the top. Do not jump through flame withi a building without first covering the hea with a blanket or heavy clothing and gau ing the distance. Don't get excited; try t recall the means of exit, and if any fireme are in sight *don't jump.*

If the doors of each apartment, esp cially in the lower part of the house, we closed every night before the occupants r tired there would not be such a rapid sprea of flames.

ACCIDENTS IN THE UNITED STATES

In 1900 there were 2,550 railway employes killed and 39,643 injured; there were 249 passengers killed and 4,128 injured; in other accidents 5,066 persons were killed and 6,549 injured, so that the total casualties for the year were 7,865 and 50,320 respectively.

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LIFE AND DEATH RATES

This table shows how many out of 10,000 persons die annually at each year up to 104. It is used by all life insurance companies in their computations of risk, premiums, etc.

Year.	No. Alive.	No. Deaths.	Year.	No. Alive.	No. Deaths.
At birth		1,539	35......	5,362	55
1......	8,461	682	36......	5,307	56
2......	7,779	505	37......	5,251	57
3......	7,274	276	38......	5,194	58
4......	6,998	201	39......	5,136	61
5......	6,797	121	40......	5,075	66
6......	6,676	82	41......	5,009	69
7......	6,594	58	42......	4,940	71
8......	6,536	43	43......	4,869	71
9......	6,493	33	44......	4,798	71
10......	6,460	29	45......	4,727	70
11......	6,431	31	46......	4,657	69
12......	6,400	32	47......	4,588	67
13......	6,368	33	48......	4,521	63
14......	6,335	35	49......	4,458	61
15......	6,300	39	50......	4,397	59
16......	6,261	42	51......	4,338	62
17......	6,219	43	52......	4,276	65
18......	6,176	43	53......	4,211	68
19......	6,133	43	54......	4,143	70
20......	6,090	43	55......	4,073	73
21......	6,047	42	56......	4,000	76
22......	6,005	42	57......	3,924	82
23......	5,963	42	58......	3,842	93
24......	5,921	42	59......	3,749	106
25......	5,879	43	60......	3,633	122
26......	5,836	43	61......	3,521	126
27......	5,793	45	62......	3,395	127
28......	5,748	50	63......	3,268	125
29......	5,698	56	64......	3,143	125
30......	5,642	57	65......	3,018	124
31......	5,585	57	66......	2,894	123
32......	5,528	56	67......	2,771	123
33......	5,472	55	68......	2,648	123
34......	5,417	55	69......	2,525	124

Year.	No. Alive.	No. Deaths.	Year.	No. Alive.	No. Deaths.
70......	2,401	124	88......	232	51
71......	2,277	134	89......	181	39
72......	2,143	146	90......	142	37
73......	1,997	156	91......	105	30
74......	1,841	166	92......	75	21
75......	1,675	160	93......	54	14
76......	1,515	156	94......	40	10
77......	1,359	146	95......	30	7
78......	1,213	132	96......	23	5
79......	1,081	128	97......	18	4
80......	953	116	98......	14	3
81......	837	112	99......	11	2
82......	725	102	100......	9	2
83......	623	94	101......	7	2
84......	529	84	102......	5	2
85......	445	78	103......	3	2
86......	367	71	104......	1	1
87......	296	64			

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CREMATION

The burning to ashes of the bodies of the dead is one of the most ancient of customs, in all countries which have had an ancient civilization. The prejudice against cremation is but one Jewish influence among the many influences that through the scriptures have had such a powerful effect upon the feelings and habits of the civilized world.

The poems of Homer show that the custom of burning the dead was common during the Trojan war, more than a thousand years before Christ. Almost every country having a long history has, one time or another in its career, very generally practiced cremation. Evidences show that it has usually partaken of a religious character.

The use of the tomb was forever hallowed among Christians by the method of Christ's burial. The belief in the resurrection of the material body from the grave caused cremation to be looked upon with abhorrence among all those who held to that dectrine.

The cremation of the body of the poet Shelley and that of his friend Williams, in 1822, drew forth a general discussion of the subject, especially among the learned men of Germany and Italy.

In 1874 the closed receptacle was first used, and the second person to be cremated therein was the wife of Sir Charles Dilke, in Dresden.

In 1878, through the efforts of Sir Henry Thompson, the first crematory in England was built at Woking, in Surrey. However, it was four years before there was a cremation and that was done privately. In 1884 England declared it was a legal process of disposal of the dead.

The first crematory in the United States was built by Dr. Le Moyne, at Washington, Pa., in which the first cremation was that of Baron de Palm. Cremation societies for the erection and maintenance of crematories now exist in nearly every large city in the world, and many distinguished persons have recently selected that process for the disposal of their remains.

In 1900, at the Fresh Pond Crematory of New York City, there were 602 bodies cremated. Nearly 4,000 have been cremated at that place. Other places of cremation show a like increase of patronage, and the custom has virtually ceased to arouse comment.

The method of the process is simple, and without any specially harrowing conditions. The furnace is raised to a high degree of heat before the body in the closed receiver is introduced, when the door is closed and the heated air and gas turned in. It requires about half an hour to complete the process, when the wholly oxidized vapors of the body have passed into the air through a high chimney, and the remaining ashes for an adult weigh from five to seven pounds. The cost is about $25, and would be one-tenth of that sum if the tom was general.

The main reasons urged in favor of method of disposal of the dead are cleanliness, speed and sanitary results. posed to it are the religious ideas of a terial resurrection and that it destroys evidences of crime upon the body. To first, the answer is given that this met is nowhere forbidden in scripture, and all things are possible with God; to other, that more crimes would thereby detected because of the scientific exam tion of every body offered for cremat

LEGAL FACTS AND FORMS

POWER OF ATTORNEY.

Sometimes it is desirable for one wh to be absent from home to empower s one else to act for him and sign his na The legal document conferring that autl ity is called a power of attorney. Such instrument should be drawn with the most exactitude, for it is a very import grant, especially if it be general in cl acter. Here is a form, with a variation general or special power indicated:

Know all men by these presents, Tha John Jones, of the City of Chicago, Cou of Cook, State of Illinois, have made, c stituted and appointed, and by these pı ents do make, constitute and appoi Henry Hárris true and lawful attorney me and in my name, place and stead, lease, sell or make any other disposit whatever of any of my property in said ci [or certain specified property] and to si seal and deliver any agreement, assignme assurance, conveyance or lease to any p son who shall purchase, or agree to p chase, such property, or any part thereof, and in due form of law to acknowledge any such instrument necessary to the proper conveying or leasing said premises, or any part thereof, giving and granting unto my said attorney full power and authority to do and perform all and every act and thing whatsoever, requisite and necessary to be done in and about the premises, as fully to all intents and purposes as I might or could do if personally present, with all power of substitution and revocation, hereby ratifying and confirming all that my said attorney or his substitute shall lawfully do or cause to be done by virtue hereof.

In Witness Whereof, I have hereunto set my hand and seal the 2d day of June, nineteen hundred and two.

JOHN JONES [SEAL]

Signed, sealed and delivered in the presence of JOHN MARTIN, Notary Public.

AFFIDAVITS AND DEPOSITIONS.

An affidavit is a written statement sworn to or affirmed by the person making the statement, before a qualified officer.

A deposition is the testimony of a witness under oath, reduced to writing, and subscribed to before a qualified officer.

BILLS OF SALE.

Bills of sale are written evidences of agreements by which parties transfer to others, for a consideration, all their right, title and interest in personal property.

The ownership of personal property, in law, is considered changed by the delivery of such property to the purchaser; though in some states, without delivery, a bill of sale is good evidence of ownership, even against creditors, provided the sale was not fraudulently made for the purpose of avoiding the payment of debts.

Juries have power to determine the fairness or unfairness of a sale, and upon evidence of fraud such bill of sale will be ignored and declared void.

Any form of words, importing that the seller transfers to the buyer the title to personal property, is a bill of sale.

FORMS OF DEEDS.

The forms of deeds conveying lands are prescribed by several states, and such forms should be generally used. The requisites of a valid deed are: Competent parties; consideration; the deed must be reduced to writing; it must be duly executed and delivered. The mode and effect of an acknowledgment or of a deed is governed by the law of the state where the land lies, and not by that of the place where the acknowledgment is taken. Where the deed is executed by an attorney in fact, it is customary to have the power of attorney acknowledged by the principal and the deed acknowledged by the attorney. A deed executed by several grantors should be acknowledged by each of them.

WILLS.

All persons are competent to make a will except idiots, persons of unsound mind, and infants. In many states a will of an unmarried woman is deemed revoked by her subsequent marriage. A nuncupative or unwritten will is one made by a soldier in active service, or by a mariner while at sea.

In most of the states a will must be in writing, signed by the testator, or by some person in his presence, and by his direction, and attested by witnesses, who must subscribe their names thereto in the presence of the testator. The form of wording a will is immaterial as long as its intent is clear.

Age at which persons may make wills is

in most of the states 21 years. Males and females are competent to make wills at 18 years in the following states: California, Connecticut, Hawaiian Islands, Idaho, Montana, Nevada, North Dakota, Oklahoma Territory, South Dakota, Utah; and in the following states only females at 18 years: Colorado, District of Columbia, Illinois, Maryland, Missouri, Wisconsin.

DUE BILLS.

A due bill is not negotiable paper, so can not be legally assigned. It is, however, a memorandum of indebtedness, and may be made the subject of an order. Sometimes a due bill is made to take the form of a note, by being made payable one day after date, or on order. To be a true due bill, in due form, it should merely state that there is a given amount in money or goods due this day to the holder.

ORDERS FOR GOODS OR MONEY.

Ordinary orders are a matter of mutual convenience, running much as follows:

$60 CHICAGO, May 10, 1902.

Messrs. Marshall Field & Co.: Please allow the bearer to purchase goods to the value of $60, and charge the same to my account.

HORACE WARNER.

An order is not mandatory. The holder is not obliged to present it, or to trade the full amount, nor is the merchant obliged to fill the requisition. In sending a stranger for any kind of movable property the sender should make out a written order and not rely on a verbal request. One should be very careful in honoring a verbal order, for it may be the person presenting it is a swindler.

When the order is for the delivery of a specified article or articles, a receipt should be given by the person bringing the order, thus:

CHICAGO, May 10, 1902.

James P. Smith: Please deliver to bearer, Henry Walker, my roadcart, left for repair. GEORGE W. JONES.

CHICAGO, May 11, 1902.

Received of James P. Smith on the order of George W. Jones, one roadcart.

HENRY WALKER.

ASSIGNMENTS.

Assignments are any simple form of statement properly witnessed, which transfers the right of property to a designated person.

SPECIAL POINTS ABOUT NOTES.

To be on the safe side, it is well to see to it that any note offered for negotiation is dated correctly; specifies the amount of money to be paid; names the person to whom it is to be paid; includes the words "or order" after the name of the payee, if it is desired to make the note negotiable; appoints a place where the payment is to be made; states that the note is made "for value received;" and is signed by the maker or his duly authorized representative. In some states phrases are required in the body of the note, such as, "without defalcation or discount;" but, as a general thing, that fact is understood without the statement.

The following rules have been compiled from the best authorities and cover the whole ground of the law of notes with accuracy and clearness:

There are two parties to a note, the maker and the payee.

If a note is lost or stolen, it does not release the maker; he must pay it, if the consideration for which it was given and the amount can be proven.

Notes bear interest only when so stated.

A note made on Sunday is void.

A note obtained by fraud, or from a person in a state of intoxication, cannot be collected.

"Value received" is usually written in a note, and should be, but is not necessary. If not written, it is presumed by law or may be supplied by proof.

The maker of an "accommodation" bill or note (one for which he has received no consideration, having lent his name or credit for the accommodation of the holder) is not bound to the person accommodated, but is bound to all other parties, precisely as if there was a good consideration.

No consideration is sufficient in law if it be illegal in its nature.

A note indorsed in blank (the name of the indorser only written) is transferable by delivery, the same as if made payable to bearer.

If time of payment of a note is not named, it is payable on demand.

The time of payment of a note must not depend upon a contingency. The promise must be absolute.

The holder of a note may give notice of protest either to all the previous indorsers or only to one of them; in case of the latter he must select the last indorser, and the last must give notice to the last before him, and so on. Each indorser must send notice the same day or the day following.

Neither Sunday nor any legal holiday is counted in reckoning time in which notice is to be given.

The loss of a note is not sufficient excuse for not giving notice of protest.

If two or more persons, as partners, are jointly liable on a note or bill, due notice to one of them is sufficient.

If a note is transferred as security, or even as payment of a pre-existing debt, the debt revives if the note or bill be dishonored.

An indorsement may be written on the face or back.

An indorser may prevent his own liability to be sued by writing, "without recourse," or similar words.

Written instruments are to be construed and interpreted by the law according to the simple, customary and natural meaning of the words used.

The finder of negotiable paper, as of all other property, must make reasonable efforts to find the owner, before he is entitled to appropriate it for his own purposes. If the finder conceal it he is liable to the charge of larceny or theft.

One may make a note payable to his own order and indorse it in blank. He must write his name across the back or face, the same as any other indorser.

An executor or administrator may indorse and transfer the note of a deceased person.

FORMS OF NOTES.

A Note Negotiable Only by Indorsement.

$200 CHICAGO, Nov. 26, 1901.

Three months after date I promise to pay to John H. Munger, or order, two hundred dollars, value received.

J. T. NORTHROP.

A Note Not Negotiable.

$200. ST. LOUIS, Nov. 17, 1901.

Ninety days after date I promise to pay Charles C. Sears two hundred dollars, value received.

SAMUEL ATKINSON.

Note Bearing Interest.

$100.

BATON ROUGE, LA., May 26, 1902.

Six months after date I promise to pay R. V. Jennings, or order, one hundred dollars, with interest, for value received.

JOHN Q. WATSON.

A Note Payable on Demand.

$150.

PHILADELPHIA, Nov. 30, 1901.

On demand I promise to pay Edgar Whittlesey, or bearer, one hundred and fifty dollars, value received.

JOHN R. CHAFFING.

A Note Payable at Bank.

$100. CINCINNATI, Dec. 24, 1901.

Thirty days after date I promise to pay Mark I. Rankin, or order, at the Second National Bank, one hundred dollars, value received.

FRANK T. MORRIS.

Guaranty of a Note.

For value received, I guarantee the due payment of a promissory note, dated October [illegible], 1901, whereby John Paxson promises to pay George Ruthledge eighty dollars in three months.

St. Louis, October 10, 1901.

THOMAS TODD.

. . .

SINGLE TAX: ITS MEANING AND ITS THEORIES

Henry George, a profound student of economical and fiscal systems, was the first popular advocate of the theory now known as the "single tax." Simply stated, it means only to charge any one occupying land the same rental value of the bare land, without improvements, taking the rent thus collected, in place of all other taxes of any sort, as public funds for public uses. It does not suggest displacing any one from land occupied and used. The supporters of this theory are very active, and rapidly increasing in number. They issue the following statement of their position:

The single tax would:

1st. Take the weight of taxation off the agricultural districts where land has little or no value irrespective of improvements and put it on towns and cities where bare land rises to a value of millions of dollars per acre.

2d. Dispense with a multiplicity of taxes and a horde of tax-gatherers, simplify government and greatly reduce its cost.

3d. Do away with the fraud, corruption and gross inequality inseparable from our present methods of taxation, which allow the rich to escape while they grind the poor.

4th. Give us with all the world as perfect freedom of trade as now exists between the States of our Union, thus enabling our people to share through free exchanges in all the advantages which nature has given to other countries, or which the peculiar skill of other people has enabled them to attain. It would destroy the trusts, monopolies and corruptions which are the outgrowth of the tariff.

5th. It would, on the other hand, by taking for public use that value which attaches to land by reason of the growth and improvement of the community, make the holding of land unprofitable to the mere owner and profitable only to the user. would thus [illegible] ssible for spe tors and m [illegible] tunities unused or only half used, and would throw open to labor the illimitable field of employment which the earth offers to man. It would thus solve the labor problem, do away with involuntary poverty, raise wages in all occupations to the full earnings of labor, make overproduction impossible until all human wants are satisfied, render labor saving inventions a blessing to all, and cause such an enormous production and such an equitable distribution of wealth as would give to all comfort, leisure and participation in the advantages of an advancing civilization.

With respect to monopolies other than monopolies of land, we hold that when free competition becomes impossible, as in telegraphs, railroads, water and gas supplies, etc., such business becomes a proper social function which should be controlled and managed by and for the whole people concerned through their proper government, local, state or national, as may be.

HOW FIRES ARE EXTINGUISHED

While cities have been growing so rapidly, and sky-scraper buildings have become such a common feature of the cities, it has been necessary to study constantly for the improving of methods for fighting fire which might destroy property of such great value. So it is that city fire departments have been organized to a high degree of perfection, both for the extinguishing of the flames, and for the saving of life of those who may be in danger. Some of the most ingenious and active of American inven- have busied themselves in this direc- eed to be told that the fire departments include men of tried bravery, whose deeds of courage almost daily rival or excel the most daring deeds of soldiers in battle.

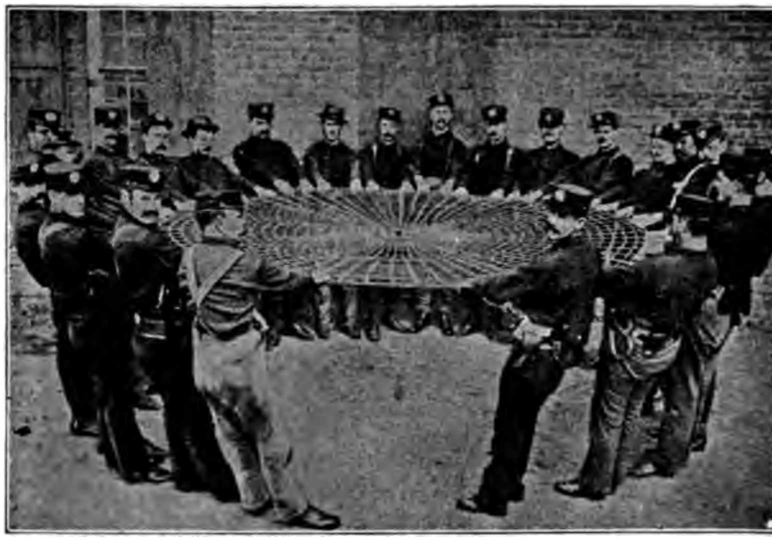
The organization of the fire department in such a city as Chicago, for instance, is a matter of the greatest importance to the entire community. It must be efficient, kept up to the highest standard of excellence, and supplied with the bravest of men and the best of material at all times, if it is to do this work properly. However much political influence may have affected the appointment and administration of the police force, the community has rarely tolerated any invasion of the fire department with political influence. The annual expenditure for the fire department is nearly $1,600,000 for the one city of Chicago. The department includes a total of nearly 1,200 men, organized in almost military fashion, with a marshal and his assistants, chiefs of battalions, captains and lieutenants, in addition to hundreds of engineers, pipemen, truckmen, drivers, stokers and watchmen. These brave men save every year many times as much as the department costs, and the citizens consider it a splendid investment to maintain it. At the slightest sign of deterioration in the fire department, or any reduction in the number of men employed in it which might reduce its efficiency, the fire insurance companies promptly raise their rates for insurance, so that the increase in premiums paid in the city far more than exhausts the slight saving made in the expense of the department.

These facts are typical of the conditions in every other city throughout the country. Even in small towns where no paid fire department is maintained, the custom is to be liberal in the support of volunteer compa-

[illegible] LADDER IN SERVICE.

gas, which discharges a stream of the liquid about fifty feet.

All firemen agree that the first five minutes of a fire are worth more in fighting it than the next half hour, so that all efforts are made to be as prompt as possible in reaching the scene of danger. Horses ready harnessed and trained to start instantly when the alarm is given, men on the alert every moment when they are on duty, and buildings properly constructed and equipped with safety in view, are prime essentials in addition to the apparatus itself. Nowadays mills, factories and large buildings of all sorts are equipped with hose, ladders, hydrants, fire extinguishers and fire escapes. The employes are organized into companies and drilled to fight fire so as to be ready for any emergency.



NET FOR CATCHING THOSE WHO JUMP FROM BURNING BUILDINGS.

There is a firemen's training school in New York, which prepares men for active service in the department before they are permitted to begin the actual responsibilities of the work, and in Chicago and other cities the same results are obtained by drill of all new recruits in the department. They are taught to handle lifelines, safety nets into which people may jump from burning buildings, and the hose, hooks and ladders themselves. They are given drill with the remarkable extension ladders and extension es w' ble fires in tall buildings 's to be made, where 'n impossible a few years ago. Then they are finally put to work as a part of the crew of an engine or a hose cart, and begin to take their lives in their hands at every call to duty. The public has an immense admiration for the firemen and they can always count on applause for their bravery and support when they need assistance in any worthy movement. There is a halo of glory about a fireman's head which is universally recognized, and until all buildings are proof against destruction by flame, which may be true, thanks to improved building methods, after many years, he will always stand in the place of distinction.

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ASBESTOS CLOTH THAT WILL NOT BURN

A long, lank, slow-voiced Englishman left his native land a score of years ago and settled in Quebec, where he hired out as a laborer in a lumber yard. His great bodily strength, supplemented by his energy and activity, soon won him an excellent position. After he had been at work a number of months he returned one cold winter evening to the capacious, shed-like building in which they all lived. Seating himself comfortably before the pot-bellied cast-iron stove, the open mouth of which glowed red with heat, he deliberately drew off his long, wet boots. Then a pair of socks, much the worse for Quebec mud, came off one after the other, and his companions saw him coolly fling them into the fire.

They made no comment on his action, but when, almost immediately afterward, they saw him reach into the stove with a poker, pull out the apparently blazing socks, and, after giving them a shake, proceed with the greatest unconcern to draw them on his feet again, they stood aghast. It was plainly an exhibition of witchcraft. Then they scrambled over one another in their haste to reach the door, through which they burst into the dark.

The next day they called on the manager in a body and demanded the instant dismissal of the Englishman, loudly declaring that they would not longer eat or drink or work with such a monster. Inquiry being made at once, it was found that the big Englishman had worked in an asbestos factory before crossing the water, and being of an ingenious turn of mind he had managed to secure some of the material, out of which to knit himself a pair of socks. When they became soiled he cleaned them in the fire. But such explanations were of no avail with his ignorant companions, and he was compelled to leave his work.

Asbestos is a wonderful substance. Its name comes from a Greek word meaning inconsumable. Fire will not burn it, acids will not gnaw it, weather will not corrode it. It is the paradox of minerals—for a mineral it is, quarried just like marble. The fibers of which it is composed are as soft as silk, and fine and feathery enough to float on water. Yet in the mines they are so compressed that they are hard and crystalline like stone.

Although the substance has been known for ages in the form of mountain cork and mountain leather, comparatively little has been learned as to its geological history and formation. A legend tells how Emperor Charlemagne, being possessed of a tablecloth woven of asbestos, was accustomed to astonish his guests by gathering it up after the meal, casting it into the fire and withdrawing it later cleansed but unconsumed.

Yet, although the marvelous attributes of asbestos have been known for so long, they were turned to little practical use until about twenty years ago. Since that time the manufacture of the material has grown until it can take its place shoulder to shoulder with any of the giant industries of this country. Indeed, so rapid has been its progress and development that there is almost no literature of any kind on the subject, and to the popular mind it is still one of those dim, inexplicable things. A dealer in asbestos goods says that the majority of persons who use the substance are firmly convinced that it is all manufactured by some secret process from wool or cotton.

Up to the late '70s nearly all the asbestos used came from the Italian Alps and from Syria, but one day a party of explorers discovered a rich deposit in what is known as the eastern townships of Quebec in Canada. Companies were at once formed, and in 1879 the mines were opened. Remarkable as it may seem, however, although the Canadians started factories, in the operation of which they were substantially backed by English capital, it was an American concern, with headquarters in New York, that developed the manufacturing industry most rapidly. The company has now grown so large that it has branches in nearly all the large cities of the country, and the machinery used is specially made and peculiarly adapted to the manufacture of asbestos articles. There are also a number of large factories in England.

The Canadian mines are located in a wild, rough country, almost outside of the pale of civilization. The hills have worn themselves bare of earth, and the bleak rocks glare out in great, bald patches. At one time a scraggy growth of pines clung to the remaining ridges of soil, but forest fires, the hand of man, and the ravages of wind and weather, have left only the dreary waste of burned and blackened stumps. The sides of the hills gape with great holes in which the men—mostly French-Canadians—are at work. The veins of chrysotile, as the Canadian asbestos is called, are from two to four inches in thickness and are separated by thin layers of hornblende crystals. The nearer to the surface the veins run the coarser are the fibers and the less valuable.

The mining is done by means of the most improved quarrying machinery. Holes are drilled in long rows into the sides of the cliffs by means of steam drills. They are then loaded with dynamite and exploded simultaneously by wires connecting with an electric battery in such a way that a whole ledge of the rock falls to the bottom of the pit at once. Then the workmen break out as much of the pure asbestos as possible and load it into great tubs or trucks, which are hoisted out by means of derricks and run along to the "cob house." Here scores of boys are kept busily employed crumbling or "cobbing" the pieces of rock away from the asbestos, and throwing the lumps of good fiber to one side, where it is placed in rough bales or sacks ready for shipment to the factory.

The greatest work in connection with the mining of asbestos is in disposing of the waste rock and the refuse of the quarry. Only about one twenty-fifth of the material quarried is real asbestos, and the rocky parts have to be lifted out and carried away to the dumps at great expense. As if in keeping with the forlorn and blasted appearance of the country the miners are a hard, uncanny class of men, migratory in disposition and exceedingly superstitious. Their wages range from $1 to $1.50 a day.

As the asbestos comes from the mines it is in small lumps of a greenish or yellowish hue and the edges are furred with loose fibers. The more nearly white the asbestos is the better its grade. The length of fiber is also of great importance, the longest being the most valuable.

From the mines the asbestos is taken by rail to the manufacturers in the United States. Here the lumps of the substance are emptied from the sacks and fed into the hopper of a powerfully built machine, not unlike an old-fashioned stone-process flour mill. They are crushed through a series of rolls, until the fibers are all separated into fluffy masses, when they pass out along a trough and into a separator. Here the small pieces of stone and other refuse rattle out through a sieve, and the longer fibers are separated by a series of comb-like sieves into various lengths. The very short ones are taken out to the pulp-mill, where they are ground up fine for the manufacture of solid packing for steam pistons, millboard and other commodities. The longer fibers are gathered together, carded, and spun into yarn, just like cotton or wool. After that the substance may be woven into cloth in various ways. The cloth is of a dirty white color and has a soapy feeling.

The uses of asbestos are almost innumerable. Ground fine, and combined with colors and oils by a secret process, it makes a beautiful paint, which is said to go far toward fire-proofing the surface to which it is applied. Various kinds of roofing are also made by treating strong canvas with a combination of asbestos and felt and backing it with manilla paper. It is extensively used for roofs of factories, railroad shops, bridges, steamboat decks and other places where there is danger of fire.

Nearly every one has seen the thick, asbestos-felt coverings for steam-pipes and furnaces. Asbestos-cement is sometimes used for hot-blast pipes and fire-heated surfaces. As a packing for locomotive pistons, valve stems and oil pumps it is almost indispensable. It is also made into ropes and mill-boards which can be used almost everywhere. Asbestos cloth is being used more every year. Some states require theaters to use an asbestos drop-curtain to protect the audience if the scenery catches fire. Some very beautiful drop-curtains have been made, and the ordinary spectator cannot distinguish them from real cloth.

The yarn is knit into mittens for workers in iron and glass. Goldsmiths use a block of asbestos to solder upon. Combined with rubber—vulcanized—asbestos has almost innumerable uses as an electrical insulator. In this form the substance resembles ebony, and is about as hard. The cloth is also of the greatest importance for acid-fitters in all kinds of chemical processes, for the reason that no acid will eat it.

Asbestos is found in a good many hundreds of places in the world beside Italy and Canada, but the fibers are nearly all splintery and brittle. Rich deposits have recently been found in Wyoming, California and Montana, and the United States may soon come to the front as a producer of the substance. With asbestos worth about $50 a ton, as it is, a good mine of asbestos is more valuable than a gold mine, and as the substance becomes better known and more used it will be still more precious. The time may not be far distant when firemen will be clothed in suits made from asbestos.

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MINERAL WOOL AND ITS USES

Since the discovery, some years ago, th asbestos could be felted together into a so of paper and used wherever a noncondu ing, noncombustible packing was need the demand for it has steadily increas New forms and new uses are continu appearing, while the supply is consta diminishing. This has led to the search a substitute.

By melting together the various min of which asbestos is composed, a ma of the same composition is easily obt but the stringy, fibrous quality which the asbestos so valuable is wanting accidental blast or stream of melt from an iron furnace gave the fi most important step in the solutio problem, and from this it has been worked out almost to perfection. At first "glass," or "mineral" wool was made largely from slag, which contains many of the minerals needed—sand, lime and iron. But this product was too glassy, was not tough enough, and melted too easily.

A careful analysis of asbestos was made, and the minerals—limestone, sand, fire-clay or kaolin and iron slag—containing the proper elements, were mixed.

As made now, by the improved methods, waste products from other factories are used principally. Broken glass from windows and from bottle houses furnishes the sand and a part of the lime; pieces of fire-clay bricks, broken glass-pots and dish-ware that has warped and cracked in the kilns furnish the clay; and iron slag from the pudding ovens supplies the iron and part of the sand and lime. A little extra limestone is added. These waste products, besides being cheaper, are better than simple sand, lime and clay would be, as they are in a hard, chunky form, and "stand up" in the furnace, allowing a better circulation of air and gas while heating. Loose sand and clay would pack.

The materials are crushed and mixed according to a rough formula, which is worked out by experiment. It is very necessary that the amount of each should be just right. If too much glass is used the wool is brittle and harsh; if too much clay, the fibers are coarse and heavy, and if too much iron, the product is dark and does not sell wel

The mixed material is placed in tall fire-brick furnaces, with alternate layers of coke, each layer being about one foot deep. Natural gas, where obtainable, is led into the bottom of the furnace, the fire is lighted and a blast of air from a blower is turned on, getting up an intense heat. The glass melts, acting as a flux, and melting the other materials. The part nearest the bottom of the furnace melts first and the whole mass settles down. When the bottom is sufficiently liquid a small hole is opened at the side of the furnace, and the liquid mass is allowed to flow out in a stream about one inch in diameter. As this falls a jet of steam from two flat, fan-shaped nozzles is directed against it, blowing it into a fine spray which, on cooling, is a white, fibrous mass resembling fine, well-washed wool, hence its name.

The spray is blown through a small window into a large collecting room. While the blast is on this room is filled with a white cloud, looking like cotton down. Two furnaces and two rooms are used, alternating with each other. When the blast is finished in one furnace, the downy wool is allowed to settle, and is then scraped from the sides, the floor and the ceiling; it is weighed, packed in bales and then is ready for the market.

The heaviest part which settles nearest the window contains little, beadlike bodies, called in the trade "shot," and due to imperfect blowing. This is remelted or sold for rough packing. The uses of the mineral wool are very numerous and are multiplying all the time. The chief ones are the adulteration of asbestos; packings to retain heat, as on steam pipes, steam cylinders and boilers; and packings to keep out heat, as in ice machines, refrigerators, cold-rooms and cold-storage warehouses. Of late large amounts are used for the deadening of walls and floors in fireproof buildings. The mineral wool is used either loose or in the form of paper, felting or thick wadding.

HOW ARTIFICIAL SILK IS MADE

Dr. Frederick Lehner of Zurich, Switzerland, has opened an active competition with the silk worm by the invention of a cheap and simple process of making an excellent quality of artificial silk. It has been known for a good many years in the scientific world that a substance of practically the same chemical composition as silk could be made, but the secret of rendering the process industrially practical remained undiscovered until Dr. Lehner took up the work. The basis of the discovery rests on the well-known truth in chemistry that many vegetable fabrics, such as waste cotton, cloth, flax, jute and wood, when digested by treatment with acids and alkalis are transformed into cellulose, a substance forming the walls of cells. By combining this material with nitric acid, certain nitrates of cellulose are formed, the higher compounds of which are such well-known explosives as cordite and tonite. The lower or pyroxylin nitrates are less explosive, being a gelatinous substance. If this be drawn out it will divide into numerous short threads or strings of a fine, shiny texture, somewhat like gun-cotton, and most inflammable when dried. To this point a great number of chemists succeeded in getting, but they could not give the product of their test-tubes a sufficient viscosity to admit of being drawn out into long threads. Dr. Lehner tried various solutions, but even when the amount of the pyroxylin was reduced to 7 per cent the compound was still too gelatinous to be worked.

At last he discovered that by adding dilute sulphuric acid to the alcohol ether solution, a part of the water was taken up and "split off" and the nitrates broken down, leaving a 12 per cent solution which was perfectly fluid and of the required viscosity. The process having once been discovered, the manufacture of the fluid is an inexpensive and perfectly simple operation for any chemist.

The method by which the common-looking yellow liquid is converted into beautiful silk threads is most interesting. The machine used is nothing more than a modification of the ordinary spinning frame. The great glass jar containing the silk fluid is set up on a high bench or shelf and the fluid is conveyed downward through pipes to a number of bent glass tubes resting in a trough of cold water. The orifices in the ends of the tubes are exceedingly minute, and rest just beneath the surface of the water. As the fluid flows through the tubes it is quicky cooled and begins to coagulate. On leaving the water about 60 per cent of its soluble portion has been washed away and the remaining thread is of a fine, rich lustre. Six o[r] seven of the strands are gathered u[p] and twisted together, exactly as sil[k] or woolen threads are spun. After [it] has been wound upon the frame the [ar]tificial silk dries and hardens, losing in t[he] process the remains of its soluble mat[ter]. In a week's time the thread cannot be [dis]tinguished from the real article even [by a] silk expert except by microscope or c[hem]ical examination.

But the thread in this condition r[etains] its characteristics as a nitrate, and [is al]most as inflammable as gun-cotto[n. Of] course it would never do for use [as] there was danger at any moment [of] blowing up. The consequences of [a] a dress made of such material may [be] imagined. Consequently the threa[d] mitted to a last process—that of denitration, in which by the use of ammonium sulphide the nitric acid is all neutralized.

After the thread has been again dried, it is really less inflammable than natural silk. It can now be spun to any required thickness, and it is said that the resulting yarn is much smoother and more even than the genuine article. It has another advantage. When the machines are once started the threads can be spun to any required length—endless, if necessary—thus obviating any necessity of stopping the cloth-looms to splice a thread. In addition to this the process can be carried on through winter and summer in any part of the world. There will be no need of mulberry forests or worm hatcheries, for by taking a quantity of cast-off clothing, and perhaps some wood pulp, and mixing them with the acids, the work is done.

Yet the artificial silk lacks in several particulars of being as good as the natural product, and it is proposed to make it an economic factor in the manufacture of real silk goods. The warp of a fabric may be made of genuine silk and the woof of the artificial silk. In this way the artificial silk would take the place of wool or cotton in a mixed fabric, which would be just as cheap and much finer.

The relative strength of the artificial silk, compared with Italian pure silk, is as 68 to 100. Pure silk has but little elasticity, and when stretched does not go back to its original length; neither does the artificial silk, but its stretching quality (before breaking) is as 73 to 100 relatively. Measure for measure, the relative weight of the same average diameters of pure and artificial silk is 7.25 per cent more in the latter.

BUTTONS, THEIR INVENTION AND MANUFACTURE

Adam did not wear buttons. Even when his wardrobe reached the dignity of containing "other clothes," he was compelled to fasten his apparel with a sash or borrow a spike from Tubal Cain. In fact, until the beginning of the fourteenth century, the world managed to struggle along without these modern conveniences. Buttons were first used as ornaments. They were sewed on according to the taste or caprice of the maker or wearer of clothing, and they were seldom placed where they might have been of practical service, even had there been buttonholes to match them. Some time in the latter part of Queen Elizabeth's reign it was discovered that a small slit cut in the cloth and shoved over the button made these ornaments useful. From that time on the making of buttons grew until it has become one of the most important industries. With the practical use of buttons came a revolution in dress. The last relic of the flowing robes handed down from patriarchal days was consigned to the shelves of museums, and the simpler modern dress was introduced.

It was the fashion in the early days of buttonmaking to sew as many buttons on the clothing as the texture would bear. Even the laboring classes managed to deck themselves to a degree which to-day appears ridiculous. This at once created a demand, and the close of the seventeenth century saw the button industry well established in Europe, the center being then, as now, Birmingham, England. The first buttons were very expensive. They were made chiefly of gold and pearl, rich in design, and inlaid with precious metals and

sired figure which the face of the finished button is to assume is cut in the upper die, the reverse being made in relief on the under die. They are stamped and pressed together without soldering.

Materials employed in button making are as varied as the styles of buttons. In addition to metal-covered buttons and those made from other metals, glass, porcelain, horn, bone, India rubber, mother-of-pearl and other products of shellfish and various woods are used. The shells for mother-of-pearl come from the Persian Gulf, the Red Sea, the Pacific coast and Panama. Paper buttons have been made, but not extensively. An English invention uses slate or slit-stone in making buttons and button bodies.

The first buttons made in the United States were of wood, covered by hand with different materials, principally silk. The operation was laborious, but it resulted in the invention of machinery which has built up large factories in the east, Waterbury, Conn., and Easthampton, Mass., being centers of manufacture in this country. New York has several large factories.

The details of preparing the sheet iron for metal and metal-covered buttons are simple. The iron is first scaled by immersing it in acid, after which it is punched out with the dies. The neck, or "collet," is japanned, after being cut, and before the canvas tuft for sewing on is pressed into place. The hollow between the neck and shell is then filled with brown paper, called "button board." The making of these basic parts of the cloth-covered button is confined almost entirely to the eastern states. Western manufacturers buy the material ready to cover. Button shanks, or eyelets, are made of wire on a machine which cuts the wire into desired lengths, bends it into loops and leaves it ready for insertion into the lower blank.

The name "shell" is given to metal buttons made of two disks pressed together and fastened without soldering. A cloth-faced button is made by gluing a piece of cloth, cut the exact size, into the top of a rubber or vegetable ivory body. This leaves a rim of hard material to protect the edges of the button from wearing. In these the thread holes are drilled through a knob turned or molded on the back of the body.

The great decrease in the price of buttons from that which made the first manufactured a luxury, has been due to the introduction of machinery, which now does almost the entire work. Skilled labor does not occupy a large place in the making of buttons, which may also account for their comparative cheapness. Girls and boys may operate nearly all the machinery, which is a combination of automatic features, leaving little to the operator but dexterity in handling the different pieces for the dies.

One of the curious freaks of buttondom, invented some years ago, was a "bachelor's" button. This consisted of an ordinary trousers button with a safety pin attachment. It was to answer in cases of emergency, but it has not succeeded in entirely banishing the more homely but reliable horse-shoe nail.

IN A TYPE FOUNDRY

Every type in a font, like every link in a chain, must be perfect in itself, or else the work of the maker counts for nothing. Perhaps in no other industry, unless it be watch-making, is such scientific accuracy required in every detail. Each measurement must be made to the thousandth part of an inch, and if a mold or a die is not exact to a hair's breadth a whole casting may be lost. For in this age of newspapers every printed page is judged to a certain extent from an artistic point of view, and if the impressions of some type are heavier than those of others, or if the alignment is imperfect or the spacing uneven, it is subjected to condemnation. In this way typefounding becomes a real art.

One of the largest manufactories of type in the world is located in Chicago and the amount of type in tons which it turns out yearly runs well up into the thousands. It is a big, busy building humming with life and movement, more than 350 men and girls working at its benches every day.

Follow the superintendent down the basement stairs, around the huge boilers and engines, and into the little corner room where the type metal is melted. Here the raw materials are brought, weighed and corded up ready to go to the big iron crucible. There are "pigs" of lead, heavier than an ordinary man can lift, "pigs" of tin and "pigs" of copper. The antimony comes from Japan in square, solid blocks weighing thirty pounds each, and before melting it is crushed to powder between the iron jaws of a crushing machine. Formerly the workmen broke it up with hammers, but the antimony being poisonous, that method was abandoned.

The four metals are mixed according to a secret formula—the lead being the largest ingredient—and placed in a crucible. Antimony, which is a most expensive metal, is used because it gives hardness to the type-composition and because it has the unusual quality of expanding in cooling, thus preventing the type when cast from "falling away" from the mold, and produces sharpness of the face and body of the type. After being melted and thoroughly mixed by stirring the metal is run into pans, and when cool it is ready for the casting machines.

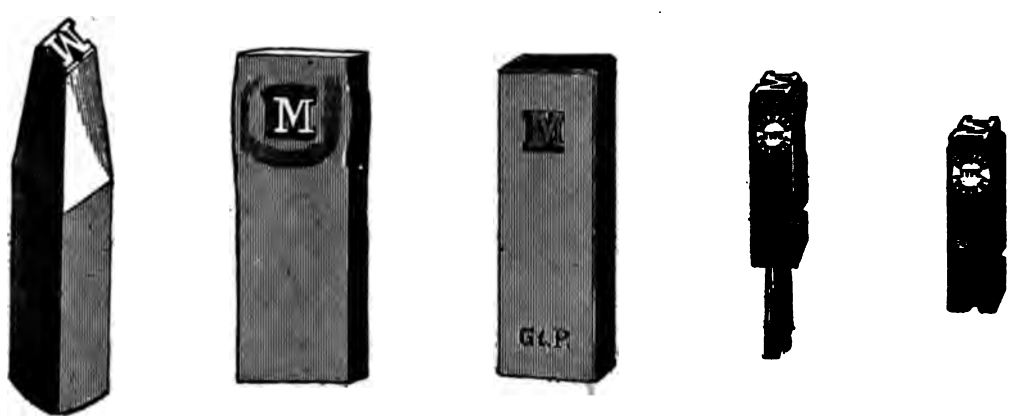
The first step in type-making is the cutting of the letters desired on the ends of pieces of hard, fine steel. This is very difficult work, and the men who do it receive high wages. Each letter in a font must be exactly the same height and the width must be cut according to rule. A separate one of these dies or "punches" is required for each character in every font of type, and the making of them is the most expensive part of the business. Some of them cost as high as $7.

When a set of "punches" is complete it goes to the matrix department. Here little rectangular pieces of pure copper known as "strikes" have been prepared. For minion or long primer type they are about two inches long by half an inch broad. At exactly the proper point near the top of each the steel die is driven in and then the "strike" or embryo matrix goes to the fitter, who rubs and polishes it down on big pieces of sandstone until it is everywhere square and perfect and the depth of the letter is exactly the same as in the rest of the font matrices. An electrotype matrix is also made, usually for use in casting display type, without going to the expense of cutting steel punches. This is done by immersing in a copper solution a piece of brass the size of a "strike" and having a hole at the upper end and allowing copper to be deposited by the action of electricity on a metal die of the desired letter, which is suspended with its face just inside the hole in the brass. Great pains is taken to keep all these molds and dies perfect. More than $200,000 worth of them are stored in a big vault in the basement.

Next the mold is made. This work requires the most skilled mechanics in steel. The pieces are all cut out by lathes, planers and shapers and ground down to just the right size and then polished on emery laps. There are two main parts to the mold, and they may be so adjusted as to make room for casting the bodies of letters of any width from a 3-m size to an i size. A great deal depends on the absolute accuracy of these molds. The matrix is now fastened in the mold so that it will form one end of the hole between the two parts. Then one of the parts is fastened to the casting machine and the other to a movable arm. The metal is kept fluid in a little furnace heated by natural gas, and is projected with great force into the mold by means of a pump. At every revolution of the crank the mold approaches the pump spout, takes a charge of metal, and flies back with a fully formed type, which is cooled with air-blasts and water from above. When the movable arm is as far back as possible, a half of the mold lifts and the type jumps out. At the lower end of each one there is a little "jet" of metal which clings and has to be broken off by an automatic device. In some of the larger styles of type the "jet" is removed by hand. When all of the a's in the font are made, the b matrix is put in, and so on to the end of the alphabet. A casting machine will turn out from 100 to 175 type a minute.

In casting small fonts where frequent changes are made in the molds, the mach are driven by hand-power; but where are large, such as those made for ne pers, steam is the propelling power ar indefatigable little machines go thu along with little or no attention a their work with a precision that equals human intelligence.

The type is not finished when i the machine. A fringe or burr, sc like that which clings to a bullet (mold, still adheres to its corners a This is taken off by a number of



TYPE IN THE VARIOUS STAGES OF MANUFACTURE.
Showing in succession, from left to right, the "punch," the "drive" or "strike," the "matrix," the unfinished type with "jet" and the finished type.

rub rows of the type on sandstone laps. The deftness and ease with which they handle the type, which would so easily "pi" in the hands of an inexperienced person, are simply wonderful. All italic and script type are sent to be "kerned." This is a process of cutting away and smoothing the body around the projecting parts of the letter, and it adds materially to the cost of these two classes of type.

The "setters," nimble-fingered girls, sit around low tables, the tops of which are cushioned in velvet. Here the type is dumped and the girls set them in long lines with the nicks uppermost. They now go to the "dresser," who slips the row into a stick or dressing-rod about three feet long, turns them on their faces, fastens them into a slit in an iron bench specially constructed for that purpose, and with a plane cuts a groove in the bottom, which removes the burr left in breaking off the "jet," and gives the type two legs to stand on. He then deftly turns the long row upside down and dresses off the uneven places along the upper and under sides. One firm in Chicago has in use a wonderful new machine which performs most of these operations automatically. It casts the type, breaks off the jets, rubs down the two sides, dresses off the body and grooves the jet end of the type. The type are cast singly, and follow one another through channels, which contain the dressing and grooving devices, onto a long wooden stick.

The work of the inspector, who now receives the type, is the most trying and painstaking of any in the shop. He sits before a big window and with a magnifying glass tightly clamped into his eye examines each type in the row, and if he sees a single defect in any of them he picks the type out with a needle-like awl and it is returned to the melting kettle. Long years of experience and keenness of vision enable the inspector to detect imperfections that would never suggest themselves even to his associates in other divisions of the industry unless their attention was especially directed to them. In the smaller sizes about one type in every twenty is thrown out, and sometimes even a greater proportion.

The lines are now broken up into shorter lines and put up in "galleys" or "pages," about four and one-half by six inches in size. The full font weighs 100 pounds, and if smaller fonts are ordered these are divided into smaller pages, each having its due proportion of "sorts" of letters and characters. After being wrapped in paper and marked they are ready for shipment.

A type font is sometimes measured by weight in pounds, and sometimes by the number of m's which it contains. Job fonts are always turned out by count. The proportion of letters in a font is interesting as showing how much more some letters are used than others. In a 3,000 lower-case m font of "minion 3," for instance, a type smaller than that from which this book is printed, weighing 280 pounds, there are 9,000 a's, 2,000 b's, 4,000 c's, 5,000 d's, 14,000 e's, 800 k's, and 500 j's. E is used more than any other letter in the alphabet. It is followed by t, with 10,000; then by i and a, with 9,000 each; then by s, with 8,000. The least used letters are z, with 300, and j and x, with 500 each. Of the numerals 0 and 1 are most used, having 700 each. Some of the fractions have fifty types to the font and the braces have only twenty-five each.

The great newspaper offices use thousands of pounds of type every year. But the introduction of linotype machines, which cast the type line by line as fast as it is set, has severely injured the business of making body type. A great Chicago dealer says that the linotype machines have cut in more than 25 per cent, the effect being felt most in the orders from the big city dailies. An effort has been made, however to fight the linotype machine with a machine which will set real type, and in this the type founders place much hope for the future. But the business of producing new styles of job type and casting them is still a great industry.

BINDING TWINE MADE FROM MANILA HEMP

One Chicago manufacturer produces enough binding twine every working day in the year to reach half way around the earth. The capacity of his manufactories, of which there are two, is eighteen miles every minute, or about 3,333,330 miles a year. The weight of the annual product is 16,000 tons, and it would stretch from the earth to the moon thirteen times, with a loose end left over that would girdle the earth nine times. If a train were to travel as fast as twine is made in the factory it would speed from Chicago to New York in about forty-five minutes. These factories make about one-third of all the binder twine consumed in the United States. The total amount would therefore be about 10,000,000 miles, or 48,000 tons. Allowing about two feet of twine for every bundle of wheat, the total number of bundles harvested would be 105,600,000,000, a simply inconceivable amount.

Chicago is by all odds the great twine-producing center of the world, and it distributes its output from China to P The largest amounts are used in Minne and Dakota, but other states are also g buyers. Of foreign countries Argentin far in the lead as a twine consumer, large sales are made in South Africa Australia; in fact, everywhere in the w that wheat will grow.

The best twine is made from East dian manila hemp. It is the product plant known to botanists as musa texti a variety of banana palm which grows in the Philippine islands. Some fa good varieties of hemp, although far ferior to the manila, are now being gr in southern Mexico. Yucatan supplies much-used sisal, which comes from a p known as the American aloe, resembling century plant in appearance. The f takes its name from Sisal, a seaport tow Yucatan. The work of cutting the fi stringing it out, suspending it on rack dry, and packing it for shipment empl thousands of the natives during a part the year. All the rest of the time they ploy in magnificent leisure, spending t earnings and waiting for the next sisal son. This Yucatan hemp is now much u although it is not as strong and durabl the East Indian products.

The various kinds of hemp come to factory storehouse in bales containing f 270 to 375 pounds. Some of them bound in rattan and palm leaves, and ered with cabalistic lettering in some eign language. Recently a little of hemp grown in Kentucky as an experim has been tried, but it was not found to fit for binding twine, which must not o be strong and smooth, but uniform in s so that it will work well in the machine.

The warehouse is three stories high,

feet long by 100 feet wide, and is packed from top to bottom with hemp bales, the entire capacity being 5,000 tons. Great caution has to be observed in providing fire protection, for if the piles of bales once became ignited it would be almost impossible to extinguish them. The superintendent has to keep a sharp eye out when the bales are unpacked, for the wily Mexicans do all sorts of things to make them weigh heavy. Oftentimes great chunks of grindstones and cobblestones, to say nothing of wood and cheaper grades of hemp, are found packed inside of the bales. It pays better than hemp-raising, and doubtless the Mexican chuckles more over getting money in this way than he would if he had earned it.

The twine factory proper is a great building. In one corner of it is one of the largest engines in the world. It has the thirty-two-foot flywheel which attracted so much attention in Machinery Hall during the World's Fair, and the indicator registers up to 2,000 horse-power. One man who stands on the clean, varnished floor is the sole master of the great engine which keeps the thousands of spindles in the factory clicking away so busily.

When the bales of hemp come in from the warehouse they are torn apart and the workmen shake out each of the separate bunches, which are knotted at the end and somewhat resemble a horse tail, only they are nearly white and very coarse, the fibers varying from two to six feet in length. So closely is the hemp packed that a bale more than doubles in size when it is loosened.

The hemp now goes to the preparing-room, where the roar of the machinery is deafening and it is impossible to speak loud enough to be heard. The room is remarkably high, so that the thick hemp dust which fills the atmosphere will be swept out and will not injure the employees. The hemp goes first to the scutching frame, which is a broad wheel about eight feet in diameter, the outer surface being covered with short, sharp pegs set close together. This is covered all over with a shield, which is pierced at one side with a square hole. Through this hole the hemp bunches are switched until the teeth have combed the fibers out straight, tearing away also a good deal of dust and short, valueless fibers.

The hemp now goes to the first spreader or breaker. This consists of two sets of belts, both covered with short metallic teeth or pegs, the first moving more slowly than the second. On being fed into the machine the hemp is spread out, carded and straightened, the second belting pulling it apart longitudinally and making the ribbon thinner. From the end of the first spreader a girl attendant, who is powdered with dust from head to foot, guides the big loose rope into high tin pails, from which it is fed into the second spreading machine, and so on through eight of them until the hemp ribbon is smooth and even and much thinner and narrower than at first.

It now goes in high tin pails to the bell machines, where it runs over numerous spools and rollers, which smooth it down beautifully, twist it and draw it out finer and thinner, making the fibers more and more compact. The picture on page 183 illustrates this part of the process. After going through two of these machines it is ready to be sent to the 600 spindles on the second and third floors.

It is difficult to give an idea of the scene in the spindle-rooms. Hundreds of machines, all just alike, with each part moving in unison, each belt flapping in line and over all a deafening sound of whirring of wheels and clicking spindles. Among the machines a few girls move about quietly, keeping them free from dust and seeing that their insatiable mouths are always full. Here the ribbon of hemp runs from the pails through a very small hole, and then it is pulled very fast, so that it grows thinner, at the same time being twisted a little. Then it is fed on a big spool or bobbin in the form of the finished twine—650 feet to every bobbin. A very complete system of inspection and examination is in use in the factory for insuring absolute exactness in the size and strength of the twine. The binder attachment of a harvester is set up in the room, and a bundle of rag bags is bound from time to time to see if the twine is perfect.

The bobbins are sent up to the balling department. Here a great number of girls with incredibly nimble fingers are engaged in operating busy little machines which wind the twine from the bobbins into the well-known shape of the twine-balls. The balls are so made that the twine unwinds from the inside out, instead of from the outside in. The balls are now weighed, and twelve of them are placed in a fifty-pound package and covered with burlaps ready to be shipped to the farmer. Twine mills are operated only about ten months in the year, beginning in the fall and continuing until late in the summer. The selling season is, of course, before and during harvest time.

HOW VARNISH IS MADE

Varnish-making is a veritable aristocrat among trades. The varnish-maker goes about his work as serenely and leisurely as though he wore fashionable attire instead of the spotless suit of overalls, which seems to be a superfluous article of clothing. The varnish factory is as quiet as the chapel of a deaf and dumb institution, except when the tap of an easy heel or the distant rumbling of a rolling barrel breaks the spell. The rush and whir of machinery, the hissing of high-pressure steam escaping from a poor joint, the rattle of loose belting and the quarrel of clashing metals are unknown in the calm precincts of a varnish factory, for the only machinery in the place is the little engine which drives the humming dynamo and the slow-moving pumps, which breathe so softly that they are noticed simply because they take up some space in the engine room.

The making of varnish requires but little manual labor, for the raw material is handled only in the case of the gums and shellac; the oil, turpentine and other liquids are pumped from the barrel to the finished varnish. It is in the handling of the raw material and finished product that the modern varnish factory is superior to the old-time ones, for the art of making varnish is the same to-day as it was eighty years ago.

Varnish was made in kettles years ago and it is made in kettles to-day. It was made of gum, linseed oil and turpentine half a century ago, and gum copal, Calcutta linseed oil and North Carolina turpentine mixed together at varying degrees of heat make the finest and most expensive varnish which polishes and preserves the wood of sleeping cars and carriages to-day. There is not a varnish-maker who does not surround his business with trade-secrets, and the uninitiated is led to believe that varnish-making is an inherited art, hande down from father to son, and something that cannot be taught by book learning or transmitted by word of mouth. But a varnish-maker who has received yards of blue-ribbon honors and dozens of diplomas and medals from various expositions, national and international, said not long ago that the true art of making varnish lay in the proper selection of raw materials and the intelligent handling of them in the process of manufacture by experienced men.

The base of varnish is gum copal, or the fossil gum found in Zanzibar, Sierra Leone, New Zealand, the Philippine islands and other places. The best gum is that of Zanzibar, and the poorest is the Manila from the Philippine islands. When the gum is received in the factory it is broken up into pieces about the size of small egg coal. The man who breaks it up, at the same time selects the gum, for in one chunk of the amber-like material there may be both transparent and almost opaque streaks; the white, transparent gum goes into the making of the best grades of varnish, the dark-colored gum into the poorer grades. After the gum copal is broken, it is run through a series of hand sifters which divide it into block, nut, chip and dust. This separation is made for convenience and economy in handling, and cuts no particular figure in the results. The gum copal is now ready for the kettle.

For first-class varnish only Calcutta linseed oil is used. This oil, as its name indicates, is made from the flaxseed of India, which, however, is crushed in England or Germany. The preference of American varnish-makers for linseed oil made in England or Germany to that made in this country, even though Calcutta flaxseed is used alike in all the linseed-oil mills, shows the relative value placed on linseed oil cake or meal in America and Europe. In America the cake and meal, which are a residue of the oil-pressing, have less value commercially than the oil itself, so the American linseed oil man tries to get as much oil out of his flaxseed as he can, and sometimes he succeeds in obtaining 92 to 96 per cent of the oil from the seed. From the linseed oil man's point of view this percentage is first-class, but the varnish man does not like it, because the extra pressure required to secure so high a percentage of the oil lets loose what are called "foots"—little particles that will not melt with heat, will not be filtered out, and in spite of all the varnish-maker can do, persist in discoloring his varnish and forming sediment in the bottom of the storage tanks.

In England and Germany the Calcutta oil meal and oil cake are regarded as desirable food products, and commercially are of more value than the oil. In his desire to obtain as much cake as possible from a given amount of seed, the English and German oil man is satisfied with about 80 per cent of the oil in the seed. No "foots" appear in the English crushed Calcutta oil, and that is the reason American varnish-makers prefer it to home product.

Before the linseed oil is mixed with the gum it is boiled. The turpentine used for thinning the varnish is the best and purest grade of North and South Carolina turpentines. The boiled oil and the turpentine are kept in large storage tanks, and drawn out when needed.

The stack is the soul of the varnish factory. Here the gum is melted, the oil is mixed with it, and the dark and secret arts which enter into the making of varnish are practiced. The stack is a high brick chimney, around the base of which are grouped a number of fireplaces, somewhat like open coke fires, which occupy hooded recesses. The fires are flush with the floor, and are supplied with air by means of air-ducts which pass from the outside of the building under the floor to the grates. The copper kettles in which the melting and mixing are done are on truck wheels, so that they can be rolled over a fire or taken off easily. Far above each fire is a large vent, leading into the stack, for the escape of inflammable fumes or gases loosed during the melting and mixing process, for those fumes must be kept away from the coke fires or there will be an explosion. By sending the gases of the coke fire up the chimney by means of flues at the base of the stack, and allowing the fumes arising from the kettles to escape through the vents far up the stack, all danger of explosions is avoided.

The copper kettles in which the gum copal is first melted are about three feet high and two and one-half feet in diameter. A loose cover fits over each kettle, and through a hole in the cover the varnish-maker stirs the melting gum with an iron tool. While the gum is melting, steam in large quantities escapes through the little funnel in the center of the lid. One of the secrets of the varnish-making trade comes into play while the copal is melting, for while one kind of the gum can be handled safely with 200 degrees of heat, another goes up to 600, and to mistake one for the other or keep the melted gum longer than it should be, means a bad mess. There seems to be an intuitive knowledge possessed by the varnish-maker on this temperature question, for, while all the gum looks alike to the unlearned spectator, the varnish-maker allows one kettle to bubb merrily at 300 degrees, while its companic on the other side of the partition is splu tering at 500. After the gum has melte a tool somewhat like a gigantic egg-beat is introduced and the melted gum whipped, preparatory to letting in th boiled linseed oil. When the oil has bee mixed with the liquid oil, the kettle is ru back over the fire once more and the gu and oil boiled again. Then it is set awa to cool, after which the kettle is taken t a room where a quantity of turpentine i mixed with the gum and oil, and the va nish is made.

But the varnish-maker, having ever b fore him a bugaboo of specks and foreig matter which might have been caught in th translucent, amber-colored liquid, fir strains the varnish through cotton befor it is pumped into the big storage tank where it is left to age for at least si months and perhaps two years, for varnish like wine, improves with age.

That is all there is in making varnish The varnish-maker must know just wha heat is best for the different gums he uses he must know just how long and at wha temperature he must boil the combined va nish and oil, and he must know to a poin how much turpentine to put into his var nish. Every stage of the process at th base of the huge stack is watched with thermometer in the kettle, for no gues work or rule of thumb is permitted whil the kettle is on the incandescent coke.

Shellac varnish is made in "churns," o barrels revolving on journals. The shella as it comes from India looks like ambe colored mica, for it is in thin sheets an almost transparent. This shellac is mixe with the proper amount of alcohol in th revolving churn, the belt shifter is thrown over and the briskly turning barrel mixes the shellac and alcohol together.

The Zanzibar gum copal comes from the coast of Africa, between the Juba River and Cape Delagoa, contiguous to the island of Zanzibar. It is dug out of the ground by the natives, who bring it on their backs to the traders, and are said to be gloriously cheated by them. These African copals are the hardest, most transparent of all gum copals, and are used only for the most expensive varnishes. The Kauri gum copal comes from the northern island of New Zealand. It enters largely into the making of the middle and most used grades. The production of this gum is an important industry, amounting to about 7,000 tons annually valued at more than $2,000,000.

Gum copal is found sometimes on the ground, but usually some feet under the surface. It is the fossil resin or gum of trees that are now extinct. An exception to this is the Kauri copal, which is the fossil gum of trees which are growing over the ground where the gum is dug up. Sometimes the natives mix in gum from living trees with the true gum copal, but the deception is easily discovered, for true gum copal has a "goose skin," as the pitted surface is called. Then, again, the false gum copal melts in the mouth, and the genuine is not soluble even in alcohol. In the office of a Chicago varnish company is a lump of gum copal which weighs 400 pounds, and this is said to be the largest piece ever found. In the cabinet of gums in this office are several specimens of clear gum in which insects have been imprisoned, and it is estimated that those bugs were in those bits of gum copal at least 6,000 years ago.

BEESWAX AND HOW IT IS PREPARED

Since the enterprising chemists and refiners went into active competition with the honey of bees and made a pure, white wax, or paraffin, out of petroleum, the use of beeswax in the manufacture of sperm candles, wax flowers and carbon papers has gone down, but the cobblers, tailors and harnessmakers still stick by the honey bee, and declare that no petroleum wax can equal beeswax when it comes to waxends for slipping through awl-holes. Chemists, artificial flower-makers, laundries and other users of wax have not all gone over to the enemy, as the 500 tons of beeswax consumed annually indicate that the honey bees have hosts of friends left.

But many of these friends require white, or nearly white wax, and the yellow wax made by the bee must first be whitened or bleached before it is put on the market. The sun is the bleacher, so all bleacheries are in the country away from the dirt and smoke of the cities, and usually in the center of large honey districts. The beeswax is sent to the bleaching house in the shape of loaf-cakes, each weighing about twenty-five pounds. These cakes are broken into small pieces and put into a vat or tub made of cedar, about five feet high and three feet across. In the bottom of this vat are two square wooden pipes, crossing each other at right angles. The tops of these pipes have a number of holes bored in them and both are connected with a steam pipe which brings the steam to them at a pressure of about sixty pounds to the square inch. From 1,200 to 1,800 pounds of wax are placed in one vat at a time, and enough water is run in to float the wax. Then the steam is turned on, and it jets up through the holes in the wooden pipes, melting the wax. The dirt in the wax falls to the bottom of the vat, and the melted wax, about three hours after the steam is turned on, is ready to be drawn from the vat.

Not far from the vat in which the wax is melted is a wooden roller about five feet long and a foot and one-half in diameter. This roller revolves in cold water, and when the melted wax, after first passing through a sieve, falls upon it in narrow ribbons, it chills at once, and, sticking to the roller, is carried around into the water. The roller turns once every second, and when the chilled ribbons of beeswax are carried around into the cooler water they fly off the roller into the water-bed.

From the cooling bed the wax is lifted on wooden forks, placed in boxes, and carried outside to the bleaching beds. These are called frames and stand about three feet above the ground. Each frame is about 100 feet long, 15 feet wide and a foot deep. In each frame half a ton of wax is spread, and there it stays for a month or five weeks, depending on the number of sunny days, for the wax is exposed to the full light of the sun. Several times a day the wax is sprinkled with water to keep the sun from melting it, and once each day two men harrow it with a rake which extends across the frame, so that in the month of bleaching every bit of wax has all of its sides exposed to the sun several times.

At the end of a month the yellow wax has turned a creamy white, and it is then taken back to the melting vat and remelted, run through the screen over the wooden roller, and brought back to the bleaching frames for another stay, this time, however, for only two weeks. By this time the beeswax is pure white, and is ready to be put into marketable shape. The boys take about 500 pounds of wax and melt it in a small tub. Near the tub is a table on which stand a large number of pans about four inches in diameter and a quarter of an inch deep. The pans are arranged in rows, for the melted wax is poured into one row at a time. Above the pans and across the full width of the table is a movable copper cylinder. It is really a double cylinder, one inside of the other, and the space between the two is filled with hot water. The melted wax is poured into the inside cylinder, and is kept in a liquid shape by the hot water jacket.

A number of small tubes lead from the inner cylinder through the water-jacket, and one valve turns the melted wax into all the tubes, so that the boy who is filling the little pans can move the cylinder along until it is over a row of pans and then can turn the valve and fill the entire row at once. In an hour the wax in the pan-molds is cold and ready to be shipped.

TAR AND ITS USES IN THE SCIENCES

Down in the Carolinas the edges of the hills frown with almost endless forests of great pines, dark and silent. From the size of the trees the casual observer would imagine that they could be used to excellent advantage for the mainmasts of great vessels, or could be cut into lumber with which to build a city. But the "poor white" of the mountains knows better. He has seen the great boles of pines perspire with sticky pitch, and he knows that if they are cut open the wood will appear pockmarked with endless knots and rotten places. Yet they have a value all their own, and the "poor white" knows how to make the most of it.

In the first place, the trees may be "sapped" for turpentine by making the proper incisions in the trunks, or they may be burned for tar. All through the forests mounds of earth—deserted tar-kilns—may be seen at the center of patches of clearing, and not far away a ruined shanty, where the tar-burner made his home while the firing was going on. The work is eminently adapted to the capabilities of the "poor white," because it enables him to work very hard for a few days in getting the mound made, and then lie about for weeks hunting a little, talking a little, and preparing as elaborate meals as the country will afford until the burning is completed.

Slightly sloping ground on the hillside is usually chosen for the site for burning tar. A hole or basin from sixteen to twenty feet in diameter and three feet deep at the center is scooped out, connecting with a covered trough through which the tar is to flow. The workmen then fell the green pines around them and cut them up, roots and all, into pieces three or four feet long and a few inches in diameter. The "piler" takes these sticks as they are brought to him and stacks them up on end in the shape of an Indian wigwam, one tier above another, until the top dwindles to a point. Sometimes more than 100 cords of wood are heaped in a single hole, the amount depending usually on the energy of the burners. Damp earth and sand are heaped over the completed pile to the depth of several inches, and it is sometimes further covered with green boughs. A flue is made at the top to furnish the necessary draft, and a number of small holes or dampers are left at the bottom.

When everything is ready the pile is ignited, and as the fire spreads through the wood the apertures at the bottom are gradually closed up and slow combustion goes on for about ten days. It has to be closely watched in order that the fire neither goes out nor burns too fiercely. At the end of the firing period the pile has settled so much that the top caves in and a bright blaze leaps up, only to be extinguished by the addition of more moist earth. About this time the spout at the bottom of the tar-hole begins to trickle with a lazy-moving brown liquid which has a pungent odor. This is the beginning of the tar flow, and is always greeted with much joy by the watchers, who know that their work is beginning to bear fruit. During the first few hours the flow is usually full of sand and charcoal, and it is promptly discarded. As soon as the stream is fairly clear it is run into barrels and allowed to cool, after which it is ready for shipment. About 17.5 per cent of the wood burned is converted into tar, and the flow lasts sometimes for two or three weeks. As high as 150 barrels of tar are taken from a single hole, but to secure so large a product the pile of wood must be very large.

This crude method of burning is exceedingly wasteful, all the gas, the acetic acid, and much charcoal being entirely lost. The tar, when taken from the holes, is usually distilled in retorts, giving off wood spirit and pitch oils. The black residuum is poured while still hot into barrels, where it soon hardens and becomes the ordinary tar of commerce. It is largely used in making tar pavements, tar roofs, tar paper and in calking ships and sidewalks to make them impervious to water.

This method of procuring tar was formerly much used, but of late years tar is so much more easily obtained as the result of the manufacture of ordinary illuminating gas that it only pays for the "poor whites" to engage in the work. So plentiful, indeed, was coal tar at one time—and that was not so very long ago—that it was almost a waste product. But the process of distillation has now become so perfect, through the discoveries of chemists, and the use of the product thus obtained is so extensive, that almost all the tar is utilized. It is simply astounding what a quantity of things can be made out of the black, foul-smelling substance which the pavement builders use so lavishly on the boulevards. Besides numerous substances which have become household and commercial necessities, dozens of drugs are manufactured from it, so many, in fact, that the ordinary drug store could not do a day's business without having many inquiries for them in some form or other.

In manufacturing these various products the tar is taken from the gas works and allowed to stand for some time in a pond, until the tar water, consisting largely of ammonia, has risen to the top. The tar is then drained away and pumped into a large upright cylinder or still of iron, and heated to a moderate temperature. More water is forced out and drained away, and then the heat is gradually raised.

The first product is a number of highly combustible and poisonous gases which are allowed to escape. Between the temperatures of 105 and 110 degrees, the products distilled are called the "first runnings," which include benzine and benzol, the uses of which are well known. O[n] raising the temperature to 210 degrees, numerous light oils or benzols are distille[d] off, and beyond this temperature the car bolic oil appears, and it is removed for th[e] well-known carbolic acid. When the hea[t] gets up to 240 degrees, creosote oil is give[n] off, and it has been found a valuable substance in pickling timber and for variou[s] uses in the arts. Above 270 degrees anthracine oil appears, and this product by [a] separate process is converted into anthracine and numerous other compounds. Naphthalene is distilled off more or less during the whole process, and can be collecte[d] in the form of crystals and utilized.

The residue at the end of the distillatio[n] is a thick, black liquid, which, upon drying, hardens and becomes as brittle a[s] glass. It is then known as "hard pitch," and upon melting it again, with possibl[y] the addition of the creosote and anthracin[e] oils, from which all the valuable parts hav[e] been removed, it is used extensively in making asphalt pavements. In such form it is familiar to the average citizen. By dissolving this hard pitch in certain tar oils, various varnishes are made, and by burning it until all the volatile parts have disappeared it becomes a high quality of coke, much used in the better class of metal working. Lamp-black may also be made by subjecting the tar to a partial combustion on hot-iron plates and conveying the smoke into cool chimneys, where it deposits its carbon.

Among the drugs which are the result of the distillation of tar are antipyrine, which became popular during the epidemic of "grip" that swept over the country a few years ago, and antifebrin, which is mad[e] from the acetic acid and aniline oil. Acetanilid is used by some physicians in preference to antipyrine, for the reason that the smaller doses of it accomplish the same purpose as larger doses of the other drug. Phenacetine and saccharin are two other products of tar. Saccharin is 280 times sweeter than sugar, so that a single grain of it will sweeten a cup of coffee without the slightest difficulty. It is used principally in treating gout and diabetes.

Another product, sulphonal, is used in treating mental diseases. Its real scientific name is diethylsulphondimethylmethan, and the patient may consider that he has fully recovered his brain power when he can pronounce it correctly and fluently. The action of sulphonal in common with a number of other tar drugs is hypnotic, causing a quiet, restful sleep in cases of insomnia caused by worry, fatigue, or even dementia and acute alcoholism. Besides those named there are scores of other drugs produced by the distillation of tar, all of them well known to the medical profession.

Salophen is a compound of carbolic acid with a number of other ingredients. It is said to be a valuable remedy in the treatment of articular rheumatism. The very latest in the long line of coal-tar products is gallanol. It is prepared by boiling tannin with aniline. It is introduced as a substitute for pyrogallic acid, having the advantage of being non-toxic and non-irritant. In the treatment of skin diseases it has been used with marked success. Cazeneuve, the introducer of the drug, reports that one of its principal uses is in the treatment of psoriasis by painting the spots with gallanol suspended in chloroform and covering them with a solution of gutta percha in chloroform.

The making of dyes and colors from tar products has become an important industry in the last few years. Any color or shade can be exactly reproduced in a beautiful and lasting form, and new combinations are being discovered every year by the chemists.

TURPENTINE AND RESIN

Dialect writers find a fruitful field among the "tar-heels" of the Carolinas, Alabama and Georgia. In the cool depths of the turpentine woods, with the gashed trees yielding up their resinous gum, the balmy air and the picturesque "hackers," "dippers" and "scrapers," with the ever-vigilant "rider" watching everything, is a phase in southern life which has long been the delight of authors and the pleasure of the artists. The crudity of the implements and the stills used in the making of turpentine and resin lends additional interest to this old industry, and the gypsy-like habits of the turpentine-makers add to their ragged, illiterate charms.

Turpentine is the distilled gum of the pine trees of North and South Carolina, Alabama, Georgia and part of Florida. The season begins when the first spring sap rises and ends when cold weather checks the flow of the tree's blood. In January or February the "hacker," with his keen-bladed ax, begins the round which ends with the season. He is the expert of the woods and knows his trees, and just how much hacking they will stand. His task is to cut the "boxes" in which the thick gum of the wounded tree will collect. A box is a wide incision about six inches deep, a wedge-shaped cut in the tree, and he hacks from 90 to 100 boxes a day. The first boxes are cut near the roots of the tree, and they are cut as close together, to the height of a man's head, as can be done without killing the pine. The hacker leaves a width of bark between each box, so as to preserve the vitality of the tree. When the trees are leased to the turpentine-makers the terms of the lease limit the number of boxes to each tree, but when it is desired to work the pine to the fullest extent the gashes are carried up to a height of twenty feet or more.

After the hacker comes the man who "corners" the boxes. This "corner" is a cut in the top of the box, to guide the sap into the cavities left for the gum, and the man who "works" the "crop" goes systematically from box to box, starting the sap anew with fresh incisions, working in this way 10,000 boxes during the season. The sap or gum fills the boxes with a clear, sticky, thick fluid, and this is removed by the "dipper." Scattered through the woods are barrels in which the "dipper" deposits the gum, which is then hauled to the still. About a quart of sap is taken from each box by means of the trowel-shaped scoop used by the dipper, and then the hacker comes along and starts the flow afresh by wounding the tree again. The turpentine-maker watches his men closely, for the tar-heels are an easy-going people and require to be urged by the "rider," who goes through the woods on horseback, examining the crop, hurrying the dippers and hackers, and sending the barreled gum to the still.

The first or "virgin" sap, which flows in the spring, makes the best resin, and the poorest is the product of the hardened gum which is left on the sides of the boxes when the sap "turns down" in the fall. This is removed by the "scraper," who moves through the woods with his scraping t gathering the leavings.

The still is a large copper vat, hoo with a close-fitting air-tight cover, in wl is a funnel which in turn is connected v the worm of the still. The worm runs d into another vat near at hand, and in vat the fumes or vapors of the heated g are distilled into turpentine. Fire ur the copper heats the gum, and the vol parts rise to the funnel, pass into the and are condensed by the water in the ond vat into spirits of turpentine. The siduum left in the vat is the resin of c merce, which is passed through a serie strainers and sieves to the barrels, wl are made on the spot. The turpent however, cannot be barreled so easily, it will work through an ordinary barrel is placed in white pine barrels, which l been coated inside with several coats strong, hot glue, until the barrel is im vious to the subtle fluid.

The trees are worked for five or six sons, and then the turpentine-maker m to another part of the woods. He sta in North Carolina, crossed over to So Carolina, and is still moving toward gulf. Forest fires destroy the pines fa than the hacker does, for the inflamm trees catch the sparks readily, and the fla sweep over the large areas before they out. Careful owners of turpentine wo have the pine straw and fallen underbr raked away from their trees before the son begins, and, collecting this materia some safe spot, wait for a quiet day, w there is no wind, and then they burn rakings.

Negroes are the common laborers of turpentine woods, but white men are ple ful. They live in rough shanties in woods, with the stables for mules and horses near at hand. No work is more healthful than turpentine making, for it is all out of doors in the depths of the balmy, health-giving pines, free from the malaria of the swamps and from sudden changes of weather.

DYES FROM COAL

Not many women know that the beautiful reds, blues, greens and browns in their dresses are made from the substance which glows in their coal-heaters.

It was not so many years ago that cochineal and madder furnished the reds, logwood the black and indigo the blues, and the expense of dyeing was sometimes almost equal to the cost of the fabrics. But that was before chemists had begun to examine coal and its products. Everybody knew that coal could be burned, and that was the end of it. No one thought of the wonderful substances which nature had fastened up in the little black lumps. At last an experimenter discovered how to make gas for illuminating purposes, and as soon as the process began to be generally used it was noticed that a brownish, pungent-odored syrup, which bore a strong resemblance to wood tar, flowed away as a troublesome by-product. After a time the scientists named it coal-tar, and then began to pick it to pieces. Marvelous substances were extracted, one after another, in quick succession, until now the number reaches well up toward one hundred, and nearly all of them can be converted into beautiful dyes.

The first of these—aniline, which is now a common commodity—was brought out in 1858 by a man named Perkins, and a number of rich mauve and purple dyes were made from it. Within a dozen years scores of patents were taken out for all sorts of coloring compounds made from tar products. To-day the vegetable and animal colors, with the possible exception of logwood, have almost wholly given place to the mineral products from coal-tar, and the cost of dyeing has become far cheaper.

Some idea of the products from coal may be had from the following diagram:

- Coal.
  - Gas.
  - Ammonia Liquors.
    - Ammonia Salts.
  - Tar.
    - Benzine group of products.
      - Magenta dyes.
      - Blue dyes.
      - Violet dyes.
      - Azo dyestuffs, including Bismarck brown and chrysoidine.
    - Naphthalene group of products.
      - Azo dyestuffs.
      - Orange dyes.
      - Scarlet dyes.
      - Red dyes.
      - Black and brown dyes.
    - Anthracene group of products, including aniline.
      - Artificial alizarin or madder, used as a Turkey-red dye.
  - Coke.

The red, the blue and the yellow are regarded by dyers as the primary colors, and, by mixing them in various proportions, almost any color can be made. The combination of all three colors gives black. Indeed, coal-tar colors are practically innumerable, and a number of great business concerns are engaged in producing them in convenient forms for the use of dyers.

In most cities where fabrics are not made to any great extent the business of dyeing is conducted mainly by small concerns, which are rather renovating establishments than dye-houses. Here faded goods, curtains, draperies and all manner of dress fabrics are recolored beautifully. The woman who has a gown of faded blue silk and concludes that she would like it better if it were a deep wine-color sends it to a dye-house. Here it is ripped apart with great care, and all the dust and grease are carefully beaten and washed out of it. Then it goes through the various liquids of the process and comes out with a beautiful new color.

The exact principle of dyeing is difficult to explain. Scientists are not yet quite agreed whether the action on the fabric fibers is chemical or only physical. Besides this it is not known why some varieties of dyes will stick by simply being poured over the fabric while others will color only those fabrics which have been prepared with a mordant. The first of these two kinds of dyestuffs are some of the aniline colors. The whole process consists simply in placing the dye in a big kettle with water, using enough of it to produce the required shade, and when the solution is hot, dipping the fabric into it. After a thorough stirring the fibers take up all the color, and the liquid left in the kettle is almost colorless.

But the great majority of dyes belong to the second class, those requiring mordants. In the original meaning the word mordant was applied to an adhesive composition for attaching gold leaf to wood or metal, and it was appropriated by the early dyers to designate a chemical which would fasten coloring matter to the fibers of a fabric. Mordants are of a great many kinds. For "setting" certain kinds of purple dyes on cotton, sumac or any other form of tannic acid, combined with salts of tin or tartar emetic, is commonly used.

The dyeing process, while it is extremely simple, requires a good deal of caution and
experience. If the cotton is unbleach
must be bleached, and this is usually
by washing it first in a slightly alk
solution, which is kept boiling furic
When the cloth comes out it is clean
still of a brownish-gray color. It goes
to the "chemical-box," where it lies
or four hours in a solution of chlori
lime, where it becomes as white as
The chloride is neutralized by dilute
phuric acid, and the cloth is then read
the dye-room.

Here it goes to a big tin tank filled
the mordant. The tank must be all
for if any copper or iron comes in co
with the cloth a stain will be the re
After remaining half an hour in the
the cotton is taken out, washed and ri
and if necessary a little ammonia is a
to neutralize the free acids, and then it
to the dye vat. It takes great skill to d
mine just how much color will dye a g
fabric to the desired shade, and the
must not remain in the vat too long.
then taken out and usually passed thr
a solution of scrap soda to fix the co
after which it is dried.

Wool as it comes to the factory is
washed and scoured to remove the gr
alkaline salts and earthy impurities,
it is then bleached with dilute sulph
acid. If hot solutions of caustic al
were used, as in the case of cotton,
wool would be dissolved. After this cl
ing it may be dyed, or woven and d
afterward. In either case it is boiled in
salts of tin solution and then goes to
color vat.

Red liquor or acetate of aluminum
frequently used as a mordant, giving br
shades when used with certain alka
colors. Turkey red oil, two to five pou

to the gallon of water, is also a good mordant.

Cochineal and madder reds, indigo blues of all shades, the use of which in dyeing was a complicated process, and fustic, quercitron bark and Persian berry yellow, have been mostly superseded by coal-tar colors. Logwood black is still used.

CARBON BLACK AND ITS USES

Few readers of books and papers have any very clear idea of the source of the black substance from which the ink used in printing is made. The general idea is that it is lampblack, the sort produced in burning resin, turpentine or crude oil with an insufficient air supply. Up to ten years ago this was the base of all the ink used, but since the wide development of natural gas, lampblack has been mainly superseded in good ink by a very superior article known as carbon black. This is made entirely from natural gas in the gas region of Pennsylvania, Ohio and Indiana.

The factory for its manufacture is a very simple affair, consisting of a long, low wooden building, through the whole length of which run double rows of gas pipe, eight to ten inches apart. These have either holes drilled in them every ten to twelve inches, or small tips, such as are used in house jets, set in at about the same distance, from which the gas burns. Above each of these double rows of jets is placed a long, narrow sheet-iron pan about four inches deep.

A stream of water covering the bottom of the pan is kept flowing steadily by means of pumps. The jets are lighted and the big flames play up against the pan, "smoking it," as a piece of cold tin held above the gas jet would be smoked. Very little air is allowed to enter, and as the water keeps the pan comparatively cool the deposit of soot is heavy.

About every half hour a sheet-iron car with a scraper above it is drawn under the pan its whole length, scraping off and collecting the carbon black. These cars work in pairs, the cars of two lines of jets being drawn by the same wire rope. As one goes to the lower end of the building, the other comes to the upper end. The rope is wrapped around a drum operated by an engine.

When the car is full it is emptied into a large trough, and the black, which is somewhat damp, is taken to the dryer, a broad shallow pan with a fire beneath. When dry the lumps are crushed. The substance is then bolted or sifted, coming out as fine as flour, and is finally packed in barrels lined with paper bags to prevent sifting out.

The product is almost pure carbon, of an intense black and very light. A barrel of it packed under a screw weighs only fifty pounds. It is so much blacker than lampblack, which has a grayish tinge, that it has two and a half times the value of the latter in producing a given depth of color. That is, one weight of it will produce the same depth that two and a half times its weight of lampblack will produce. It is also very free from the fault of packing and sticking together. To these last two properties it owes its great value as an inkmaker, producing a very brilliant black ink that runs freely and is less pasty and sticky than that from lampblack.

Besides being used in inks, carbon black enters into the composition of black paints, varnishes and lacquers, gives brilliancy to manufactories. The eastern states are so densely populated, and the streams so contaminated with refuse and sewage from factories, that animal life is rapidly disappearing from the watercourses in many localities.

Although the gathering of pearls from the fresh-water shells of North America is a matter of comparatively recent date among the present inhabitants, it really goes back very far into the unrecorded past. The first European explorers speak frequently of the number and beauty of the pearls in the possession of the natives. No particular attention, however, was given to the subject in the United States until about forty years ago.

In 1857 a pearl of fine luster, weighing 93 grains, was found at Notch Brook, New Jersey. It became known as the "Queen pearl" and was sold to the Empress Eugenie of France for $2,500. It is to-day worth four times that amount. The news of this sale created such an excitement that search for pearls was started throughout the country. The Unios at Notch Brook and elsewhere were gathered by the million and destroyed, often with little or no result. A large round pearl, weighing 400 grains, which doubtless would have been the finest pearl of modern times, was ruined by boiling to open the shell. Within one year pearls were sent to the New York market from nearly every state—in 1857 fully $15,000 worth. The excitement gradually abated, however, until in 1868 there was a slight revival of interest, and many fine pearls were obtained from the Little Miami

GROUP OF PEARL FISHERMEN IN CAMP.

Showing the long-handled tongs with which the shells are drawn from the bottom of the rivers.

river, Ohio. Some of the finest American pearls came from near Waynesville, Ohio, in 1876. Since 1880 pearls have come from comparatively new districts farther west and south, Kentucky, Tennessee, Texas and Florida first contributing to the supply.

Next the interest extended to the northwest. During the summer of 1889 a quantity of magnificently colored pearls were found in the creeks and rivers of Wisconsin. Of these more than $10,000 worth were sent to New York within three months, including one worth $500, and some were equal to any ever found for beauty and coloring. These discoveries led to immense activity in pearl hunting through all the streams of the region, and in three or four seasons the shells were almost exterminated. Wisconsin has produced nearly $500,000 worth of pearls since 1889.

The northwestern pearl excitement subsided in a few seasons, as the others had done in turn before, by the exhaustion of the mussel beds. About every ten years or so a new wave of interest rises in connection with fresh discoveries, at some point where the shells have lain long undisturbed; it again absorbs the attention and excites the imagination of the country around, and spreads to other parts of the country; a fresh campaign of ignorant extermination is carried on for several summers, then the yield is exhausted, and there is nothing more but to leave nature to recuperate, if possible, and slowly to restore, in limited amount, the abundant life that has been destroyed.

A BARGE LOAD OF PEARL SHELLS.

The gathering of shells from the rivers of the upper Mississippi valley has become an industry of great magnitude. Such cargoes of shells are brought to the button mills, and buttons are made out of them, after the search for pearls has been completed.

In 1897 Arkansas developed a rich yield of pearls, and the excitement extended to Indian Territory, Missouri, Georgia, Tennessee and Kentucky. In fact hardly a state has been exempt from a period of excitement over pearl discoveries. The upper Mississippi valley, of late years, has proved to be a fruitful field for the pearl fishers. Streams in Iowa, Illinois and Wisconsin have been worked with great regularity and large profit. Farmers' wives and daughters, as well as the men of the families, have shared in the search of the streams flowing into the Mississippi.

Along the Mississippi river several large factories have been established for the making of buttons and ornaments from the beautiful pearl shell of the mussels. The largest of these are at Muscatine, Davenport and Sabula, and at Cedar Rapids, on the Cedar river. In the past the valuable material has been entirely wasted in the search for pearls.

The shells are most abundant in swift and clear water, where the bottom is sandy or gravelly and the country rock calcareous. While still numerous in many streams, they have greatly diminished within a few years past, wherever the pearl-hunting enterprise has extended, and are at some points nearly exterminated. The pearls found are few, and those of marketable value represent the destruction of thousands of shells for every pearl obtained. The wealth of Unios that fills our rivers and streams is rapidly being destroyed by ignorant and wasteful methods of pearl hunting. Either some form of protection is important, or if that be not possible, a diffusion of information as to better methods and the introduction of the tools used in Germany for opening the shells far enough to see if there are pea contained without destroying the anim which may then be returned to the water

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PRECIOUS STONES, REAL AI ARTIFICIAL

A recent conversation with Mr. Kunz Tiffany's on attempts that have been ma to produce artificial rubies and diamor and on other subjects relating to precic stones, elicited the following informatic

"In 1888 quantities of artificial rub were sold in Paris," said Mr. Kunz. "Tl were readily distinguished from the ger ine by experts because of tints of color culiar to them, and by the presence round bubbles, proving them to be of ig ous origin. Quite a number got ir the New York market before they we discovered, and several dealers in ge were bitten. The Paris jewelers at fi insisted on the arrest of the swindlers, l the latter returned the 800,000 francs th had been paid for the bogus rubies, a the gems must now be sold as artificial, a not as real, under the penalty of the la I described the difference at that time l fore the Academy of Science, and receiv letters from the other side inviting my operation in floating the artificial ston which are still ocasionally sold as re rubies.

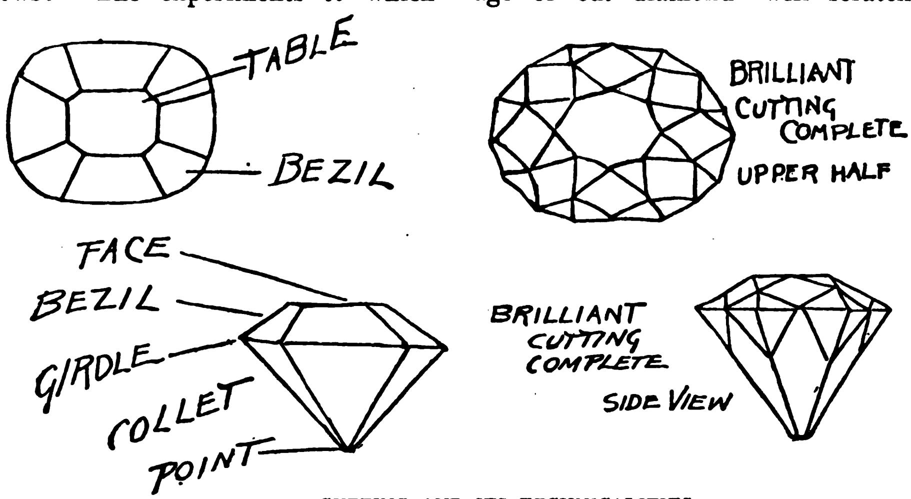
"They were made by fusing an alumi ate of lead with a silicate and bichrom of potash. The color was very good. buyer sent to Ceylon for sapphires once w cleverly deceived in the matter of col by being shown sapphires in the blue roo where they appeared to be of a decide blue tint; but when he got them out of t blue room their tint was gone. Dealers often place stones before mirrors which throw light through them. A diamond in no place looks so well as before a mirror with candles. An electric light is stationary, but the flicker of the candles gives the stone unnatural brilliance."

"Didn't Mr. Edison once attempt to make artificial diamonds?"

"Yes, and rubies and sapphires, and there was so much talk about it in the public press that I wrote to ask him whether his results were satisfactory. He responded as follows: 'The experiments to which you refer were given up because it was found impossible to produce stones free from bubbles, which render them useless for cutting edges.' This referred to their use as points for the phonograph, but the same objection would render them valueless as gems. In reference to a published statement that the Cowles Electric Smelting and Aluminum Company is suffering an infringement on its patent for making artificial diamonds by means of an electric furnace, Mr. Cowles, the inventor, informs me that the statement is incorrect, in so far as it relates to the subject of artificial diamonds, they never having produced any. Therefore another reputed artificial diamond discovery has been withdrawn.

"An impression seems to prevail that a diamond will not break if struck with a hammer on an anvil, and more than one fine stone has been shattered in attempted tests, thus proving the fallacy of the assertion. While the diamond is very hard, it is also very brittle and can easily be broken, and, although every substance from the hardness of feldspar up—including a cleavage or cut diamond—will scratch glass, nothing but the natural edge of a diamond crystal will cut it. If a stone will scratch corundum and is not scratched by a diamond, it is safe to assume that it is a diamond. It is well to make the trial on a smooth or polished surface, otherwise the scratch will not be perceptible.

"The largest diamond mine in the world," continued Mr. Kunz, in reply to a further inquiry, "is owned by the De-Beers Mining Company at Kimberley, South Africa. The stock of that company now amounts to about £20,000,000, or



DIAMOND CUTTING AND ITS TECHNICALITIES.

$100,000,000, and since the company was organized it has found 38,000,000 carats of diamonds, weighing over nine tons. In the rough they were worth more than $250,000,000, and after cutting, over $600,000,000, which is more than the entire yield of the world during the preceding two centuries, but of the whole product not more than 8 per cent can be said to be of the first water, 12 per cent of the second water, and 25 per cent of the third water, while the remaining 55 per cent is called bort, a substance which, when crushed to powder, is used for engraving and cutting hard substances. This bort, however, must not be confused with the bort-carbon (carbonade) found in Brazil, an incrystalline form of the diamond which, from its structure, is adapted for use in drills for boring and tunneling rocks. It has never been found in South Africa, and is worth from six to ten times as much as bort."

"What was the most important diamond found in South Africa?"

"I should say the Victoria or Imperial diamond. The original crystal weighed 457½ carats, or over three ounces Troy. Strange to say, although this is the largest diamond of modern times, its early history is very obscure. It is reported that the stone was found in the Kimberley mines in the month of July, 1884, by a mining inspector, and sold by him to some illicit diamond buyers, and afterwards to a syndicate of European dealers. The stone has been cut, and in its finished condition weighs 100 carats. It is a beautiful, perfect steel-blue diamond, and the largest white brilliant known. It is valued at $200,000. Among some other large diamonds may be mentioned the Du Toit, which weighed 244 carats when found; the Jagersfontein, 209¼ carats; the Tiffany yellow, weighing 125 3-8 carats after cutting; the Great Orange, 110 carats; the Porter Rhodes, weighing 60 carats after cutting; the Dudley, 46½ carats, and a number of others. More diamonds weighing over 75 carats after cutting have been found in the African mines than were ever before known.

"There was a question at one time whether the Kimberley mines could be profitably worked at all, because from one-fifth to one-quarter of all the yield, it was estimated, never reached the proper owners. The native diggers swallowed and concealed the diamonds in every possible way. It became necessary for the companies, in self-defense, to take extraordinary precautions against this great loss. Overseers or special searchers were appointed, who made the most thorough examination of all who left the mines. The natives use very ingenious methods for the concealment of the gems. On one occasion some officers, suspecting that a Kaffir had stolen diamonds, gave chase and caught up with him just after he had shot one of his oxen. No diamonds were found upon the Kaffir, it is needless to say, for he had charged his gun with them, and after the disappearance of the officers dug them out of his dead ox. Diamonds have been fed to chickens and a post-mortem examination held a few years ago over the body of a Kaffir revealed the fact that death had been caused by a sixty carat diamond which he had swallowed. Early in the history of the mines a detective force consisting of men, women and children was formed, and the severest punishment is still inflicted on transgressors of the diamond act.

"None but those authorized by law, termed patented agents, less than fifty in number, are allowed to purchase or even to possess rough diamonds at Kimberley. The loss would not have been so great but for the irregular diamond buyers, 'I. D. B.'s,' as the 'fences' are called, who lowered the price of stones by underselling the companies in the London market."

"Have any diamonds been found in the United States?"

"Yes, frequently; but none of great value. The occurrence of diamonds in the United States is chiefly confined to two regions, geographically very remote and geologically quite dissimilar. The first is a belt of country lying along the eastern base of the southern Alleghenies, from Virginia to Georgia, while the other extends along the western base of the Sierra Nevada and Cascade ranges in northern California and southern Oregon. In both cases the mode of occurrence has several marked resemblances. The diamonds are found in loose material, among deposits of gravel and earth, and are associated with garnets, zircons, iron sands, monazite, anatase, and particularly with gold, in the search for which they have usually been discovered. This resemblance is due altogether to the fact that these loose deposits, in both regions, are merely the debris of the crystalline rocks of the adjacent mountains and therefore present a general similarity, while the ages of the rocks themselves are widely different.

"The finding of a twin crystal of diamond weighing four and one-third carats at Dysartville, N. C., a three-carat stone near Atlanta, Ga., and a three-eighths-carat stone at Montpelier, Adair County, Ky., are worthy of mention in connection with the finding of diamonds in the southern states.

"During the year 1893, several interesting discoveries of diamonds were made in the United States. In December my attention was called by Prof. William H. Hobbs, professor of mineralogy and metallurgy in the University of Wisconsin, at Madison, to a diamond that had been found in Oregon township, two and a half miles southwest of Oregon village, in Dane County, Wisconsin. Through his courtesy the stone was sent to me by the finder, Mr. Charles Devine, of the place just named. The diamond was found by him while husking corn in October, 1893, in a rough stony field, which had been under the plough for forty years. The bank of clayey earth in which it was found contained a large number of rounded pebbles of quartz, but no other of the associated minerals of diamond, and as the entire district consists of glacial drift coming from the north a diamond bed is not likely to exist in the immediate vicinity, but is rather to be looked for in the direction from which the drift came.

"The diamond is a rhombic dodecahedron, deeply pitted with circular, elongated, reniform markings. In color it is slightly grayish-green. But it is one of those diamonds in which the color is likely to be superficial, and it would probably cut into a white gem. Its weight is 3 14-16 carats. This is the second authentic occurrence of diamonds in Wisconsin, the other being at Plum Creek, Pearcy county, of three small stones, the largest of which weighed 25-32 carat. A 16-carat diamond was reported to have been found, also in glacial drift, at Waukesha, Wis., in 1884. Some litigation resulted from its finding, and considerable which was expressed at the time as to the genuineness of the discovery.

"A small elongated crystal seven millimeters long and four millimeters in diameter, weighing three-fourths of a carat, and of a bright light canary color with polished surfaces was found in the vicinity of Kings mountain, North Carolina, during the summer of 1893. Mr. H. S. Durden of the California State Mining Bureau reports that two small diamonds were obtained in 1892 and 1893 at Cherokee, Butte county, Cal. One weighed two carats."

"What do you mean by the expression 'first water'?"

"The expression 'first water' when applied to a diamond denotes that it is *free from all traces of color, blemish, flaw or other imperfection, and that its brilliancy is perfect. It is, however, frequently applied to stones not quite perfect, but the best that the dealer has, and they may be only of second quality.* It is almost impossible to value a diamond by its weight only. Color, brilliancy, cutting and the general perfection of the stone have all to be taken into account. Of two stones, both flawless and of the same weight, one may be worth $600 and the other $12,000. Exceptional stones often bring unusual prices, while 'off color' stones sell for from $60 to $100 a carat, regardless of size. The poor qualities have depreciated so much in value that some are worth only from one-tenth to one-fourth what they were worth twenty years ago. This is specially true of large stones of the second or third quality."

"Are rubies worth more than diamonds?"

"Yes, the finest pigeon blood-colored rubies found near Mandalay, Burma, are worth from five to ten times the value of diamonds of equal weight. The acquisition of these Burmese ruby mines cost the British government a vast sum of money. On the wars of 1826 and 1852 England expended $75,000,000 and $10,000,000 respectively; and after all that sacrifice of treasure the Burma and Bombay Trading company claimed that King Thebaw of Burma had arbitrarily revoked the leases by which the company controlled the output of the ruby mines near Mandalay.

"The war of 1886, which followed, involved the raising of an army of 30,000 men and an outlay of $5,000,000, but the British government gained control of the long-coveted ruby mines. The question next presented was, how should they be worked? Several firms were desirous of securing a lease, and after the Indian government had virtually closed with Messrs. Streeter & Co., the London jewelers, at an annual rental of four lakhs of rupees (£40,000) for a term of five and a half years it was at first revoked, but after a time was given to Messrs. Streeter & Co., who organized the company known as the Burma Ruby mines (limited), and sent a force of engineers and a quantity of machinery to Burma.

"The ruby mines of Burma are situated in the valley of Magok, fifty-one miles from the bank of the Irrawaddy river and about seventy-five miles north of Mandalay, at an altitude of 4,200 feet. Concerning these mines very little was known, as they were always the monopoly of the crown and jealously guarded. It was said that they paid King Thebaw's government 100,000 rupees per annum, and one year 150,000 rupees. Mining was carried on by forty or fifty wealthy natives, who employed the poorer townspeople at liberal wages. All the gems were sent to Ruby hall, Mandalay, to be valued.

"One thing at least we learned from the British occupation of Burma, which is, that King Thebaw did not own the dishes of rubies which were said to rival anything known. An examination of the jewels, now deposited at the India museum at South Kensington, proved that there was only one cabochon ruby of fair, not fine, quality, and several polished sections of large inferior crystals of emeralds, of any value among his entire crown jewels.

"In 1882 a very remarkable discovery of sapphire was made in the Zenskar range of the northwestern Kashmir Himalayas, near the line of perpetual snow. A landslide removed an abundance of sapphires which were first used as gun-flints by the natives. One writer speaks of having seen about a hundredweight of them in the possession of a single native. Traders, however, soon carried them to the distant commercial centers, where their value became known. There was an instant rush of jewelers' agents to the locality of the mine, and the price rose rapidly until about £20 an ounce was paid for the rough sapphires.

"The Maharajah of Cashmere promptly exercised his authority and sent a regiment of Sepoys to take possession of the mines, and harry the natives, who were suspected of having stones in their possession, or knowledge of new localities where the gems could be found. Any one who had money was suspected of either having sold sapphires or being about to purchase them, and was despoiled and even imprisoned. This naturally had the effect of compelling secrecy. Several crystals were found weighing 100 to 300 carats each.

"Public interest in semi-precious stones has increased greatly during the last few years. Formerly jewelers sold only diamonds, rubies, sapphires, emeralds, pearls, garnets and agates, but at present it is not unusual for almost any of the mineralogical gems, such as zircon, asteria, or star sapphire or star ruby, tourmaline, spinel or titanite to be called for, not only by collectors, but by the public, whose taste has advanced in the matter of precious stones as well as in the fine arts.

"Cat's eyes came into fashion when the Duke of Connaught gave his bride an engagement ring set with one. The best cat's eyes come from Ceylon and Siberia. Moonstones were discovered in the province of Canda, Ceylon, during the search for cat's eyes, and they have been so popular that at least 100,000 have been sold in this country within four years."

VALUE OF DIAMONDS

Diamonds averaging one-half carat each, $60 per carat.

Diamonds averaging three-quarters carat each, $80 per carat.

Diamonds averaging one carat each, $100 per carat.

Diamonds averaging one and one-quarter carats each, $110 per carat.

Diamonds averaging one and one-half carats each, $120 per carat.

Diamonds averaging one and three-quarters carats each, $145 per carat.

Diamonds averaging two carats each, $175 per carat.

In other words, the value of the gem increases in the geometrical ratio of its weight. Four diamonds weighing together two carats are worth $120; but one diamond weighing just as much is worth $350. Stones weighing over two carats are about the same price per carat as two-carat stones; they should be dearer, but they are not, simply because the demand for them is limited. If the demand for diamonds were as imperative as the demand for flour or beef, the geometrical ratio would again come into play, and five-carat stones would be valued in the thousands.

HOW SHEET MUSIC IS PRINTED

Most people sing popular songs, but few [illegible] music represents. [illegible] it may be [illegible] that an ordinary [illegible] selling, say, for 10 cents, [illegible] more than 5,000 separate types.

Chicago is one of the great musical publishing centers of the country, and its daily output ranges through all the grades of vocal and instrumental literature, from the symphony for full orchestra, reproduced for the first time from the manuscript of the Chicago composer, to the cheapest reprint of the newest thing in [illegible]. Woman is on an equality with man in this department of the publishing trade. She commands a man's wages for the [illegible] position, and, as the work is of the most delicate and annoying kind, her patience and dexterity usually give her an easy superiority over the men of the guild.

A composer with a piece of music to publish has his choice among four kinds of printing. If he be rich, he may have the score engraved on copper and printed as if it were an expensive picture, or he may have it stamped in zinc, or it may be lithographed. But if he is bent on money-making and celebrity he will go to the musical type-setter.

One of the foremost music compositors in Chicago thus describes the art of translating a composer's copy for the printing press:

"When we receive the copy we read it to see how many measures it contains, how long the measures must be, and how many of them ought to be set on one staff to give the piece its best and most convenient arrangement for the performer. The 'copy-reader' counts all the notes, rests, sharps, dots, naturals, grace notes, appoggiaturas, slurs, runs and signs, and estimates just the number of 'ems' each will require. The copy is marked with corresponding directions and is given to the compositor.

"The case of the music printer is divided into 700 boxes, one of each character, and the compositor must have 'learned her case' perfectly or she will be able to make poor headway with her work. First she sets the character for the clef and the end of the staff. Then she inserts the sharps or flats of the signature, and spaces out the staff with short pieces of brass rule. Next she pieces together figures and staff rule to indicate the 'time.'

"Suppose the first note of the piece of music is a quarter-note in the second space, with a sharp before it. The compositor puts in the sharp first, and fills up the space with bits of brass rule to continue the staff; then she inserts the body of the quarter-note with two lines below, and above it she puts the two types necessary to make the stem of the note and to keep the staff unbroken. If the note is dotted, five more separate types must be inserted.

"A measure of eight consecutive notes, three-four time and a tenor clef indicated, seems to contain ten characters. As a matter of fact it contains seventy-eight at the very least, and more if the measure has accidentals, or a complicated harmony. Even the blank spaces between the notes represent five separate pieces of type, but when the music has long runs, from the top of the keyboard to the bottom, as in Paderewski's 'Minuet,' the composition is made extremely difficult, for all the added lines above and below the staff have to be embedded in a mass of 'quads' and spaces so that the notes may not be displaced in handling the form or in taking proofs.

"The more ornamental or brilliant a piece of music is, the more complicated it is to set in type, because all the slurs and marks of expression have to be fitted in between the notes just as a bricklayer fits bricks into a cornice, only the compositor cannot chop his type in two to make it fit, as a mason can divide his bricks.

"It takes four or five years for an apprentice to learn the trade through and through, and then she keeps on learning every day as long as she remains in the business. Women are successful at this trade and it offers good opportunities to them. They get just as much a page for composition as men are paid, and they make faster compositors, because their fingers are more delicate and their natures more patient.

"It is asked often whether we have to be musicians to set this type. No, not exactly, though it is essential for us to know enough of theory to avoid mistakes due to careless or indistinct copy. Composers write illegibly when they are under the influence of inspiration, just as poets do, and sometimes they put their notes where they should not be. Correcting proofs is not pleasant where the types are jumbled together as ours are, so we try to know enough music to avoid errors."

Music type is made only in Philadelphia on this side of the Atlantic, and its cost is so great that it never is put to the wear and tear of actual use in the press. As soon as the proof has been corrected by the composer the form is sent to the electrotyper, who makes a matrix in wax and returns the form to the compositor. After that comes the tedious process of distributing 5,000 types of 700 different kinds. This work is laborious because the electrotyper's wax gets into the spaces and sticks all the types together.

Although the first cost of the typographical process is several times as great as any other, it is the cheapest in the end, for when the form has been electrotyped it may be reproduced indefinitely for use on all kinds of presses and on any kind of paper. Next in importance is the lithographic process. The composer's copy is estimated, as before detailed, and then is copied in reverse on a plate of zinc. First the plate is put through a ruling engine, which engraves the five lines of the staff. Then the engraver, with separate dies and punches of steel, stamps in the plate the notes, rests and bars of the score. The plate is hammered on the reverse side until all the "burr" is removed. The plate contains all the characters, precisely the same as for the plate printing. The lines are filled with a thick transfer ink, and the plate is carefully wiped with a swab and potash. From this plate an impression is taken on paper in a regular etcher's plate press, and this transfer in turn is conveyed to the surface of a lithographic stone. From this point the process is the same as that used for the production of posters in one color, the stones being kept wet with water and the ink adhering only to the characters of the music.

If it is desired to print only a few copies of the music, the expense of lithography is avoided by using the zinc plates direct, as in card plate work. To do this, however, it is necessary to fill the incised lines with beeswax, otherwise the impressions would take up too much of the ink and be blurred or embossed by the heavy pressure of the press.

The ink used in this sort of printing is of a special nature, prepared fresh daily from Frankfort black and light boiled oil. It is a smooth, oily substance, wholly unlike the tarry ink used on ordinary presses. The plate presses themselves are of a peculiar pattern. A heavy bed of iron supports the engraved plates with the moistened paper laid upon them. A capstan wheel with six arms moves this iron bed between two large iron cylinders moving in the same direction. A heavy blanket of felt around the upper cylinder is forced upon the paper, and the impression is imparted by the ink in the engraved lines of the plate. As these presses have to be run by hand, and as the plates have to be inked and wiped after every impression, it costs half a cent a sheet to print music in this way, but the clearness of the print exceeds that of any other process except copper engraved with the burin.

The tools used in punching the zinc plates in the process here described are of a peculiar kind. Each sort of note, rest and expression mark has its distinct tool, but the *stems* and hooks are not connected with the bodies of the notes, as the engraver must be prepared to copy all kinds of curious conceits of the composer. On the face of the die used to stamp the body of a note is a slight ridge, which fits into the line of the staff on which the note is to be indicated. This device makes it possible for a skilled man to copy a manuscript with great speed and precision.

After all the body characters of the page have been punched, the plate is reversed and hammered to straighten it and the workman attaches the stems and hooks, puts in the grace notes, and cuts the slurs with a graver. If the words of a song are required, he stamps each letter separately to correspond with the note to which it is to be sung.

In this connection it is interesting to note the curious dread felt by some young composers lest their compositions be pirated and their fame be lost or gained by some stranger. In Chicago several engravers are kept busy with work which the authors refuse to submit to music publishing houses lest they be robbed of their glory. In some cases composers are so jealous of their laurels that they refuse to commit an entire work to any single printer or engraver, but parcel out one page to this man and another page to some one else.

Some musical copy is written with notes a quarter of an inch thick, on a staff two inches wide. A famous Chicago composer writes all his scores with a blue crayon, and so loosely that the engraver ought to make a complete study of harmony and thorough-bass before he begins to copy the notes. Other equally good writers make their notes with stub pens, and with such care that any musician could read them in concert at first sight.

ROPES AND ROPE-MAKING

Spinning yarns is a favorite time-killing recreation with sailors. It is said that this term, used to designate long-drawn-out tales of land and sea, is derived from the "yarn-spinning" process which is unique to the old-fashioned rope walk, in which all hawsers, cables and other cordage were made in the "good old times." Literally and figuratively, spinning yarn is a long-drawn-out process, for a rope walk is from 1,200 to 1,500 feet long, and the spinner, in his work, walks backward the entire length of the elongated building. Machinery has ruined this picturesque craft, but many rope walks still remain, and some sailors prefer the hand-made to the machine-made article.



FROM THE HEMP TO THE FINISHED ROPE.

All cordage an inch and over in circumference, goes under the general name of rope. If smaller than that it is known as cord, lines, twines and yarns. Excepting for steel and iron rope, hemp is the fiber which is the staple of the ropemaker. As this fiber is seldom longer than three and a half feet, it must be twined and twisted together to unite it into one long yarn, which is the unit of a rope no matter how large and heavy it is.

To prepare hemp for the yarn-spinning, the fiber is first "heckled," to remove the tow from the "line," and also to divide the fiber into finer strips. A series of the "heckle boards" is used, graduating from coarse to fine. This board consists of a wooden plank, studded with many sharp-pointed steel prongs. The workman takes a handful or a "strick" of hemp, and draws it through the steel prongs, thus combing the fibers and straightening out the tangles. The loose stuff, dirt and tow, also come out, and then the heckled fiber is handed to the man before the next heckling board. A little oil is put on the hemp to facilitate the operation, and when the hemp is straightened, cleaned and split up into fine threads, it is ready for the spinner.

Any boy who has played around a hay mow knows how to make a rope out of hay. He knows that by pulling a wisp of hay partly out from the mow, and twisting it, walking backward all the time, he can twist a long rope, for the twining hay catches more hay, and thus the rope is made. Spinning hemp fiber into rope yarn is done in much the same way, except that the twisting is done by a "whirl," and the hemp is carried around the waist of the spinner, who feeds it out as he walks backward the length of the rope walk.

The "whirls," generally a dozen in number, are set in a frame in which is a large, flat-rimmed, wooden wheel. Sometimes the wheel by direct friction spins the "whirls," which are simply steel hooks set in wooden spools, and sometimes the "whirls" are spun around by a belt which passes around the wheel and all of the spools.

The spinner, after placing a bundle of dressed hemp around his waist, with the ends in front of him, twists some of it in his fingers and fastens the twisted fibers to one of the whirl hooks. An assistant turns the wheel and the hook spins around, twisting the fibers to the right. The spinner walks slowly backward, feeding out the hemp to the yarn by drawing it from his waist with his left hand and letting it slip between the thumb and fingers of his right hand, which are protected by a piece of woolen cloth.

He takes care to supply the hemp equally to the yarn, and sees that it enters the twisted part by the ends and not in the middle. As the yarn lengthens the spinner throws it over hooks set in posts to keep it from the floor, and when he reaches the end of the rope walk a second spinner takes the yarn from the whirl, gives it to another man, who attaches it to a reel, while the second spinner begins his backward journey down the rope walk. The first spinner holds his yarn tightly so that it will not untwist, walks toward the reel as his yarn is reeled in, and when he arrives there waits for the second spinner, who attaches his yarn to the one first made, so that the yarns are joined in one continuous piece.

After "warping" or stretching the yarn to one length, it is passed through hot tar, if tarred rope is to be made. Tarred rope is not so strong as white rope, but it will last longer when exposed to water, so that almost all rope is tarred. Sometimes the yarn is taken from one reel to another and made to pass through hot tar on the way, a roller squeezing off the surplus tar, so that just the right quantity is put on. Yarn for cables requires more tar than yarn for hawser-laid rope, and for standing rigging it is sufficient if the yarn be merely covered with tar.

The next process in ropemaking is to form the strand. A rope is made up of a certain number of strands, the strand being made from two or more yarns. When three strands are laid or twisted together they make a hawser-laid rope; three hawsers laid or twisted together produce a cable-laid rope or cable, and when four strands are laid around a core or central strand the rope is called a "shroud-laid" rope.

The yarn is twisted to the right; when yarns are made into a strand they are twisted to the left; the three strands in a hawser are twisted to the right, and the three hawsers which make the cable are twisted to the left. Thus, in each successive process the twist is reversed, and this serves to make the rope tight and hard. If the twist is too hard the rope is weakened and the principal fault in hand-made rope is due to the fact that the inner strands are looser than the outside ones; this throws all of the work on the outside strands, for they will not stretch as much as those inside.

In forming the strand, two or more yarns are attached to a single hook which twists the yarn to the left. Then three or more yarns are attached, separately, at one end to as many hooks as there are yarns. All of the yarns are hooped together in a single hook at the other end, and this hook, turned in an opposite direction to the turn of the other hooks, and this double twi ing, regulated by the ropemaker, who sees that each strand gets its proper twist, lays the rope. This twisting is done by a machine called a "former," which travels on rails down the rope walk. Cables are made from hawsers in the same way.

Machines for ropemaking are composed of revolving or twisting parts, standing parts, and reels or bobbins on which the yarn, strands and rope are wound as fast as they are made. In the simplest machine there is one fixed and one revolving section. If that part which holds the bobbins on which the yarn or strands are reeled is fixed, then the part which receives the twisted product on reels or bobbins revolves.

Some machines combine the operations of forming the strands and laying the rope. In this machine three flying or revolving bobbins form the three strands. All of this part of the machine revolves, so that the three strands are twisted into the rope, which is reeled up as fast as it is made on the revolving portion, which receives the strands and lays them into rope. This combination makes a complicated machine, with many gear wheels and bobbins and reels, and it may be vertical or horizontal. Heavy cables, however, are still laid in the old-fashioned rope walk.

The Chippewa Indians in northern Wisconsin make crude rope in a primitive manner from the inner fibers of basswood bark. They loosen the fibers by beating the bark, and after cleaning them, twist them into yarn and strands, afterward twisting the strands into rope. They do not rely on the twist to hold the fibers together, but tie knots in the rope at intervals, and it is strong enough to be used in holding their tepee poles together, and for such use as the Indians put it to. When the Puritans landed in New England they found the Indians making cord and twine out of wild hemp, which they heckled and spun by hand. Ropemaking was one of the first industries established in America, and in the eighteenth century American-made rope was held in high esteem all over the world.

SHODDY—WHAT IT IS AND HOW MADE

Shoddy, in the popular sense, is applied to clothing of inferior quality. To the average mind the term simply means that the goods are poor, and the uninformed person has practically no idea of what shoddy really is. In reality, shoddy is a commodity which admits of a great deal of comparison, for in the business world no less than forty different grades and qualities of shoddy are marked and sold, and instead of shoddy always being an indication of poor goods it may be that the goods are all the better for it.

Shoddy is the product obtained by shredding woolen cloth into wool again. It varies as greatly in quality as do the original wools. It is used in combination with new wool in the manufacture of all sorts of woolen cloth, and if the dame who is too proud to consider for a moment a dress goods which contains shoddy, could analyze some of the combination cloths of wool and silk, and indeed most any of the woolen or semi-woolen garments she wears, she would be sure to find more or less of shoddy in them. The article is never used alone, and is chiefly used for weight.

The manufacture of shoddy commences with the collection of the rags from which it is made. The rags sold by the prudent housewife to the itinerant vender are resold to the rag jobber. There are a number of dealers in rags in this country who do millions of dollars' worth of business every year, and the shoddy manufacturer obtains his stock from these. Before being shipped to the shoddy-mill the rags are sorted, and the woolen ones are the only ones used for the purpose in hand.

When the woolen rags come to the mill in great bundles, they are first dusted. Mixed wools from everywhere are thrown together, all colors, soft worsteds, rough jackets and all the rest. The dusting is done by a machine which very much resembles a grain duster. The rags are thrown into a large semicircular box in which revolves a large wheel fitted with wide paddles. The light dust is blown out at the top of the machine and the heavy dust falls out at the bottom. After being thoroughly dusted the goods are sorted.

Great heaps of them are thrown before girls seated at long and wide benches. Here piece by piece the rags are examined and separated into the many different grades, by fingers rendered deft by long practice. The finer grades, such as the several worsteds, the fine black tailor goods, the light flannels, stockings and the like—there are forty grades to be made out of the several kinds of cloth before the process is finished—are thrown to themselves, and the heavier grades are kept separate. The work is done rapidly, and at the rate of 35 cents a hundred pounds the girls make good wages. In England the sorters receive 8 cents a hundred pounds.

After being thus sorted out, the rags are further prepared for dismemberment by separating from them all portions of cotton, even to the smallest bit of thread. Tl process is varied and differs in the sever mills, and one of the secrets of the trade in this portion of the work. In the o process all this work was done by hand, an in the old country mills—at least in some them—this practice is still continued. I most American mills, however, the comp tition has become so strong that a short and cheaper process has been found nece sary, and instead of the hand work the co ton is taken out by a chemical process.

The rags from the sorting room are take to another portion of the building, and a plunged into a hot bath. The water i this bath is chemically treated, and therei lies the secret. Sulphuric acid is the chie component of the mixture, and the exac formula varies. This bath eats out all th cotton, rendering it so rotten that th woolen pieces will fall away from it whe there is the least bit of force applied Thence they are thrown into a patent dry ing arrangement known as a hydro-ex tractor.

This machine consists of a large, tub like vessel of steel, which is perforated all over with holes of good size about two inches apart. This "basket," as it is called, is about two feet deep and is surrounded by an iron vessel constructed so as to catch all water which comes out of the perforations in the basket, the whole resembling an old-fashioned set of miller's wheels in place. The rags are thrown into this basket, and the latter is so connected that when power is applied it revolves at a rate of about 1,500 revolutions a minute. The water in the rags is thus forced out of the holes in the side of the basket by the centrifugal force, and when the rags are removed from this extractor they are about as dry as though they had passed through an ordinary clotheswringer.

From the extractor they are placed in a drier, where steam pipes are run above them, and a current of air is forced over the pipes and through the rags, emerging at the bottom of the drier. The current is controlled by a revolving fan, and the drier generally consists of a long, box-like arrangement, the upper portion of which is filled with the steam coils, the rags being thrown on wire netting and stretched across it transversely.

When thoroughly dry the rags are run through an "extract duster." This duster is practically the same as the one used at the beginning of the process, except that the dusting is more violent. It is designed to thoroughly remove every portion of dust, cotton particles, such as portions of thread or small patches in the garment dismembered, and, in short, all substances other than the pure wool. The machine does the work very effectively. Then the pure woolen cloths are sent to the dyerooms, where they are dyed as wool from the animal would be.

Only the principal colors are used—blues, blacks, browns and the like — the several shades being obtained by the mixture of the rags in the process later, just as in the work with new wool. The mordant used in the dyeing process is the ordinary chrome mordant, made from a solution of bichromate of potash and acetic or oxalic acid, the former for the blues and the browns, the latter for most of the other shades. From the mordant bath to the dye vats is but a short distance, and after being boiled the requisite time in the color vats, the rags are again passed through the patent clotheswringer, called the hydro-extractor, and are ready for the final process, which is, in short, the tearing of the rags into the original wool.

Before being shredded the rags are mixed so as to form the shade desired in the shoddy. They are spread out on a floor and are mixed by hand, there being no small degree of skill required to so distribute goods as to bring a new color by the combination, but when they finally are properly mixed the rags are wet down with ordinary wool oil. This oil is thoroughly shaken up and is applied to the rags by a hand sprinkler.

The rag picker comes next. It is a machine simply constructed, consisting of a cylinder revolving in a circular box. The rags are fed into it by means of fluted rollers, held in place by weights. On the cylinder are 11,000 steel pins, so arranged that as they catch the rags the latter are shredded. The threads are pulled apart, and when the threads are separated, even they, too, are separated into the woolen hairs which compose them. The rag picker also separates the good wool from the bad, throwing the latter out at the top and passing the former out at a point below the feeding place, but on the same side of the machine. It corresponds to the wool picker in the process of preparing the wool from the animal, and is preliminary to the work of the carding machines which follows.

The carding machines comb the wool particles more thoroughly, and turn out the product ready for use in the spindles at a woolen mill, in connection with the new wool used. The product, after it has passed over the revolving cylinders of the carders, fitted with the thousands of small teeth which separate, combine and reseparate it time and again until it is thoroughly combed out and mixed, is of a uniform shade and in the shape of long, fluffy rolls. It is then packed into bales under hydraulic pressure, and is shipped in this form.

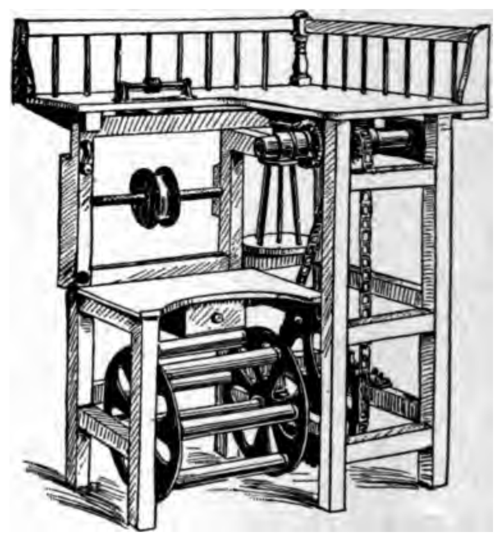
As it is used, shoddy may or may not be poorer than original wool. The shoddy made from the ordinary grades of woolen rags is not so good as the new wool, for although the product to the ordinary observer resembles the new wool, the hairs are shorter, and, after having gone through the wear and tear of the life of the garment and the process of shredding, are not so strong. The shoddy made from fine woolen goods, such as worsteds or fine flannels, is in many respects better than the new wool of the ordinary grades, the hairs being longer and the texture finer.

When, therefore, the charge is made that shoddy is used in the construction of a certain cloth, it is well to specify what grade of shoddy is used, and what quality of cloth the combined product is supposed to be, for a cloth containing a good grade of shoddy may be better cloth in many ways than another cloth which consists entirely of new wool. More shoddy is manufactured in the United States than in any other country in the world. It is the industry which makes $7 suits and $10 overcoats possible.

BROOM-CORN AND BROOM MAKING

Brooms for the whole world are made in America, and the greatest broom-corn fields on earth are about Arcola and Tuscola, Ill. A few brooms are made in Europe, but far the greater number are imported from this country, and most of them from a district included within a radius of 200 miles from Chicago. There are about 1,100 establishments interested in the manufacture of brooms to a greater or less extent in this country, and there are as many more establishments engaged in the manufacture of the supplies needed in broom manufacture. It takes about 10,000 persons to keep the housewives of the civilized world supplied with brooms.

Broom-corn grows practically the same as cane. The standard variety reaches a height of about eight feet on an average. The dwarf varieties, used in the manufacture of whisk brooms and similar articles,



BROOM-MAKING MACHINE

grow to a height of four feet or thereabouts. Only the top part of the stock—the "tassel"—is used in the manufacture of brooms.

These tassels are shipped to the factory in bales containing from 200 to 300 pounds of the long straws bunched together on their stems. When about to be used, the corn is taken from the bale and immersed in water in a large tank, which generally is just outside the door of a long, low, wooden building, the typical broom factory.

After receiving a bath of water the corn is dipped in a dye bath, dark-green in color, yet not very strong. This dye brings to the corn the greenish tint characteristic of good brooms, and colors the red portions of the stock to the uniform hue; the red in the corn is considered a bad point in quality.

After its dye bath the corn is thrown into a great covered box, through the bottom of which arise the fumes of burning sulphur. This process of bleaching brings to the corn the proper yellow body color and leaves the corn in a condition to be easily cut with the knives and machines of the workmen. When first it comes from the field it is too brittle for work.

After being bleached the corn is thrown on a large table, where it is sorted. First, the stem is cut off just above where the straws commence to grow out. This allows the outside and lower straws to be stripped off, and these are the best quality of straws, and, under the name of "hurl," are used for the outside of brooms. Other straws are stripped off and, under the name of "self-working" straw, form the body of the broom.

What is left, under the name "insiding," is that straw on which the broom is built. The insiding sometimes is divided into two qualities and the self-working straw often is called the "shouldering," as it is used to give to the brooms the "shoulder" portion of their form.

When the broom straws are thus sorted they are turned over to the winder, who builds up the broom on a machine peculiarly crude for one which does such good work. The machine consists of a table-like arrangement, at the edge of which is a revolving hollow shaft into which a ready-made broom handle can be placed and there securely clamped.

A spindle of broom wire is arranged so as to conveniently play upon the broom handle as it revolves with the hollow shaft. Power is applied by means of a "squirrel cage," so that the machine can be turned forward and controlled at will, and can be reversed.

In the lower end of every broom handle a small hole is bored, and when the workman has placed a handle in the winder the end of the wire is passed through this hole, and a few twists of the machine firmly bind it in place. Under the angle of the wire, stretched from the spindle feeder to the broom handle, the workman places a bunch of insiding or coarser straw, and gives the handle another turn by means of the squirrel-cage arrangement.

The stub ends of the straw are then trimmed off with a knife and after one or two rounds of wire have been run around the handle, bunches of the shouldering are bound down to the handle on opposite sides of the piece, and after the stub ends of this have been well trimmed, so as to give the shapeless mass something of the form it is to be later, a strap is slipped around the whole and is fastened so as to hold the flying straws in place.

The wire, too, is held in place for the time being by a strong tack driven into the handle so as to cover the wire with the head. The workman then takes two large bunches of the finer straw—the covering—and as the broom handle is revolved he dexterously spreads the covering around the whole mass. This coating of the finer straw is repeated, and the whole is again held in place by a strap. The ends of the finer straw are trimmed and the wire is fastened by a tack, around which it is wound.

A "lock," or tin covering, of fancy shape and design, is tacked on the handle so as to cover the ends of the straws, and a string replaces the strap as the broom is unclamped from the machine to be passed to the presser and sewer.

The broom press is simply an improved form of vise, so made that a broom can be placed in it, handle downward, and considerable pressure be applied to it. Most hand presses are formed of two very strong boards securely bolted upright to a base, which permits them to move. These boards are brought together at the top to form the vise by a double lever which produces great pressure between them with a comparatively small use of hand power—two horsepower pressure being applied in most cases. Other presses consist of a similar clamp arrangement worked with a screw. These are considered easier, but less effective in operation. Into one of these presses the broom is placed and the pressure applied. The straw is forced into about the shape usually seen in brooms, and the workman then sews it.

A strong flax cord of fancy color is passed around the broom twice, and the workman then threads his needle with it and passes it through the broom at intervals of about an inch, all the way across. The needle used is large, with blunt ends, and has the eye in the middle. The sewer wears a thick leather palm for a thimble, and the sewing is done with remarkable deftness. When the sewing across the broom is completed the handle of the broom is forced further into the press, and another seam is sewed. In the best brooms four seams are taken, in the cheaper grades three and in poor grades only two are taken. After being sewed and pressed the brooms are "scraped" or combed out by a large wooden cylinder, from which project many sharp spikes. The finishing process is the trimming of the broom off square at the end.

The machinery and processes thus described are in use in most of the factories over the country, especially where the best brooms are made. The machinery is crude but effective. Steam machinery has been introduced with but little, if any, success. A workman can press and sew ten dozen brooms a day, and a machine is claimed to have a capacity of forty dozen brooms a day with a man and a boy running it. This rate, however, is not maintained by a machine in actual work.

There are many special materials demanded in broom making. The wire, for instance, is a peculiar steel, tin-plated article, most of which is made in Massachusetts. The broom handles are generally of hard maple taken from the Michigan groves. Often they are made of ash and basswood. The tacks used are of a special make, tinned, strong and not brittle. The cord for sewing, generally of yellow or green or red, is of a wonderfully strong flax spinning.

Every season nearly six thousand acres of broomcorn are planted and grown along the line of the Illinois Central railroad in central Illinois. A number of farmers in that part of the state have made this their principal crop for many years and it has proved profitable. Consequently Illinois has the largest broomcorn field in the world.

Much corn is raised in Kentucky, Missouri, Kansas, Texas and other states, but the crops are scattered and irregular and are not of so much profit to the producer. The corn seems to thrive best on timber-land soil, and the rich, black loam of the greater portion of Illinois is too rank for it, the product from such soil being very coarse, red-topped and kinky, the latter quality being fatal to its usefulness.

The varieties considered the best are known as Missouri evergreen, Kentucky green, and shaker green. The corn is graded by its color, fiber and general condition. The corn of the best fiber is raised in Texas, where often the straws are four feet long. This sort of straw is especially valuable for covers. For ordinary work short but fine fibered corn is considered the best and this is the sort generally raised in Illinois. Broomcorn first grew in the swamp lands of South America.

WIRE AND ITS MANIFOLD USES

This has been called the "age of wire." The man who baptized the last quarter of the nineteenth century with this synonym for "fin de siecle" referred to telegraph and telephone wires, but he builded better than he knew. The many common, every-day things into which wire enters, either as an essential constructive element or an important factor, justifies any one in calling these years the "age of wire." Besides the hundreds of thousands of miles of wire which are strung on telephone, telegraph and trolley poles, the hundreds of thousands of miles used for fencing, and innumerable miles wound around field magnets and armatures of dynamos and motors, coils and transformers, and other things accessory to the electrical industry, wire is woven into hundreds of thousands of square yards of netting, cloth and screens; tons of it are made into pins, needles, hairpins, and hooks and eyes; millions of pounds are cut to lengths, headed and pointed into nails of all kinds; vast quantities are curled into corkscrews; tons upon tons of it are sewed into books, pamphlets and magazines; miles upon miles of it are put into pianos and other musical instruments, and every day brings forth some new use for the valuable metallic string.

One of the most recent utilizations of wire is found in its adaptation as a strength-giving covering for steam pipes. The plan of winding steam pipes over eight inches in diameter with copper wire is pronounced by engineers to be an important innovation, since the wire doubles the bursting strength of the pipe so wound. Copper pipe is treated in this way, and another important result has been secured, for the thickness of the sheet copper composing the pipe may be reduced to the minimum without weakening it.

In practice the copper pipe is wound with steel wire, the copper of the pipe being reduced to the thinnest possible gauge. The spaces between the wire and coils are filled in with copper, deposited there by the process of electroplating, and thus increased strength all around is secured.

Perhaps the most interesting phase of this use of wire comes in winding great pieces of ordnance to increase the strength of the monstrous cannons. Wire-wound guns have reached their highest state of development in England, and many of Great Britain's new battleships are armed with them. Although the practice of winding guns with wire began but a few years ago, in England hundreds of such guns, ranging from 12-pounders used by the horse-artillery, to the enormous 12-inch guns which stick their wicked noses through the portholes of barbettes and turrets on modern English battleships, are found in his majesty's service on land and sea.

The system of winding a large gun with wire is simple, for it is done in a lathe which is but an exaggerated form of the machine found in any shop. The wire used is steel, and is ribbon-shaped instead of round. For a 12-inch gun, which weighs 46 tons, the dimensions of the wire are 6-100ths by 25-100ths of an inch, and 102 miles of wire are wound around the barrel.

The wire is not wound around the barrel proper of the gun, but around the steel hoops which are shrunk around the tube that carries the projectile. The tube of the gun is first surrounded with layers of steel hoops, or in the case of the new 12-inch guns, with one steel hoop which grips the tube from end to end. Over these steel hoops the wire is wound in successive layers, varying in different guns from nine to seventy-eight layers in depth. The gun to be wound is "chucked" in a lathe, and the drum on which the wire is wound is placed over the gun on a shaft which automatically works with the lathe and is controlled by a brake.

The end of the wire is tucked under a ring of metal on the gun and screwed down, and then the power is put on to the lathe, which turns the gun around, winding the wire around as it revolves. The steel ribbon is wound on the barrel of the piece at an average strain of 40 tons to the square inch, and the wire, reeled off the drum, is "spooled" on the cannon until the desired number of layers are in place. Then the last end of the wire is screwed down under a metal ring, which is turned down to the face of the wire.

When the winding is complete, steel hoops are shrunk on over the wire, so that the exterior of the gun does not show that wire is used. Thus a wire-wound 12-inch gun consists of four tubes or cylinders; first, the barrel proper, then the steel hoop shrunk over the inner tube, next the wire cylinder made of many layers of steel ribbon, and last the external steel hoop shrunk over the wire.

Guns are wound with wire to increase the transverse strength, so that danger from bursting is reduced to almost "nil," as engineers put it. It is said by naval experts that the powder is not made that can burst a wire-wound gun, for the very nature of the material and the way it is laid on regulates the tension, so that the whole of the material of the gun takes up its proper proportion of the strain when the pressure is greatest, which is at the moment of firing.

The wire is wound on under such great tension that it practically becomes part of the hoop which it envelopes. This hoop is shrunk over the tube with such extreme care that it is one with the tube, so that the entire fabric of the gun, although made up of four layers, responds at once and at the same time to any pressure, and the office of the wire is to distribute this pressure over the whole piece. The hoops, besides giving transverse strength to the tube, also give the gun "girder" or longitudinal strength, so that it is stiff and will not bend under its own weight. The wire does not give girder strength to the gun. It is there for another purpose.

It was feared at first that a shock striking the wire would break through several layers and the wire would uncoil. But it has been found that the friction between the strands of wire is so great that, even though several layers be cut, the wire will not loosen. And then care is taken in winding the gun to tuck under the wire at intervals.

The process of winding guns with wire has lessened the time consumed in making a large piece considerably. Prior to the introduction of the wire-winding system, from fourteen to sixteen months were consumed in making a twelve-inch gun, but now it is made in less than ten months. Of this time four to five months are taken up in the preliminary work of forging, turning, annealing and testing; from six weeks to two months are used for winding, and the balance in finishing the gun.

The constructive work leading up to the wire winding consists of forging the tube from the steel ingot and rough-boring the forging. At the same time the hoops for the jacket are passing through the same process, and when the tube is annealed, hardened and annealed again the hoops are shrunk on by heating them until they expand enough to permit the workman to slip them over the tube. Then the gun is wound with the wire, the outer hoops are shrunk on, the tube is bored and rifled. The rifling is a delicate operation, requiring the best tools and most skillful workmen, for each groove must be cut separately, and there are forty-eight grooves, all of which must be exactly alike.

The hardening at the Woolwich arsenal in England is done by heating the tube and plunging it in a bath of oil. In annealing the tube it is heated to about 900 degrees Fahrenheit in a suitable furnace, and allowed to cool gradually.

Although wiring guns is a modern process, the very first cannons made were wound with rawhide and leather to increase the transverse strength, and shotgun barrels were made some years ago by winding soft iron wire on a mandrel and welding the wire in one solid piece.

FIREWORKS AND THEIR MANUFACTURE

When Thomas Jefferson wrote an account of the adoption of the Declaration of Independence, he said that in years to come patriotic Americans, no doubt, would celebrate the day by memorial exercises, speeches and songs, and by the firing of salutes with cannon and the burning of fireworks and illuminations. It is not likely that in his most prophetic moments the author of the Declaration foresaw how literally and extravagantly his suggestion would be carried out. The amount of money burned up annually in the explosion of fireworks on the Fourth of July, not to speak of the incidental conflagrations that occur in every city as a result of careless celebration, is almost incalculable. The same amount expended in another way, within the course of a century, would erect public libraries, schools, memorial buildings and monuments to celebrate the gaining of our national independence, in every town and village in the United States.

Nevertheless it is hardly to be expected that the national habit will change abruptly, or that the manufacturers of fireworks will find their business diminished as a result of a sudden increase in popular wisdom.

The American fireworks makers are far

by girls who arrange a number of , of the thin, tough paper upon a ing marble slab, brush paste upon the of the sheets, and with the palms of nand roll the firecrackers, one at a time, r the paper, thus coating them. The ecrackers are dried for some time and en packed, and are ready for the Fourth : July.

The Chinese or the Hindus were the irst makers of fireworks, and probably gunpowder or something like it was burned on festival days several thousands of years ago in China. The plains of China and India have large deposits of saltpeter, which is one of the chief ingredients of gunpowder. It is supposed that the first man who made gunpowder was an Indian or Chinese, and that the discovery was accidental. For years saltpeter was called "Chinese snow," and the records of early travelers through China show that the Chinese used their "snow" to make "earth thunder" and "devouring fire." The accidental discovery that a mixture of charred wood and saltpeter would make a flashing material, easily led to mixing sulphur with it, and gunpowder was the result.

Now nitrate of potash and chlorate of potash are two of the most important constituents of fireworks. They supply the oxygen which is required in an explosive, for an explosive is nothing but quick combustion, and combustion cannot take place without oxygen. Heat of course must be applied to start the oxygen, and this is done either by percussion, as in a cartridge, or by a burning fuse, as in a skyrocket.

In fireworks the colored effects are given by the burning of sulphur, sulphides of arsenic, iron and steel filings, and other metals, such as sodium, which gives a yellow fire, calcium red, strontium crimsoı barium green, and copper green and blu when reduced to powder and mixed wit the oxidizing agents.

But whatever the mixture is, it mu have something to supply the oxygen, an it is said the Chinese found that out nearl 2,000 years before Columbus discovere America. Now they make their gunpowd according to the white man's method, bu immense quantities of roman candles, sk rockets and pin-wheels of English an American manufacturers, and in a fe years may have to come to America fc their firecrackers.

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MATCH MAKING IN VARIOUS COUNTRIES

One of the evils which the working pe ple of France are trying to remove from th industrial body is the use of white pho phorus in the manufacture of match The poisonous fumes rising from the p in which the material is heated, and constant handling of the stuff, give workmen in match factories the hor phosphorus necrosis, a disease whic tacks the bones, disintegrating the t and causing untold suffering. The I government, which has a monopoly manufacture, has endeavored to matchmakers to daily, before leav works, gargle their throats with ch potash, a counter-poison to phosph the working people do not observe and in turn ask the governme amorphous phosphorus and salts instead of white phosphorus. material is the cheapest, howev slow poisoning of French r still goes on.

The French method of making matches differs in some particulars from that employed in Sweden and this country. The French match is made of splints produced from fir and poplar wood, except when the splints come from Russia, where vast quantities are made from the aspen tree.

The splints are made by machines, which turn out about 300,000 an hour each, and one of the great government works in France uses up over 24,000,000 of these splints in a day. They arrive at the factory in large cases, and are sent through the works in batches of 7,000 or 8,000 at a time, each batch being arranged in a square frame called a "batteau."

A splint-laden batteau is placed in a machine, which automatically separates the splints, so that each of the 7,000 has a little space around it, and is thus isolated from its neighbors. When the splints are arranged in this manner the form in which they are held is called a "press," and it is capped on one side, leaving the other with the splint heads exposed. The presses are carried to the dipping-room, which is filled with the poisonous vapors of phosphorus and sulphur. The men who labor in this place are so accustomed to the irritating, tissue-eating vapors that they work as unconcernedly as if the air were pure and wholesome.

The visitor, however, is seldom able to remain in the room more than a minute or two at a time, for the fumes cause uncontrollable coughing, and choking and gasping add to the discomfort.

PUTTING THE CHARGES INTO ROMAN CANDLES.

In one corner of the room stands a vat in which melted sulphur is held. The workman, taking the press in both hands, dips the splints in the compound two or three times, withdrawing the press with a jerky motion which shakes off the surplus sulphur. The splints are prepared for the sulphur bath by being heated. The phosphorus compound is made into a paste and spread evenly over iron plates, which have the same area as the presses. After the splints have been dipped in the sulphur, the press is laid, open side down, upon the paste-covered iron plates, and the splints are gently forced into the sticky mixture.

When withdrawn from the paste each splint has a little knob of phosphorus on it, and has become a match. A drying operation, which gives the phosphorus tips a glossy consistency, follows, and then the presses are taken to a machine which takes the matches from the press and places them uniformly, and with heads all pointing in the same direction, in another form. From this form the matches are placed in boxes, either by machinery or by the skillful fingers of girl operatives. The form is laid in the machine and is covered with glass, so that the girl can watch the descent of the matches, which fall down of their own weight.

At the bottom of the form is an opening, just the size of the inside of the box. Back of and opposite to this opening is a plunger of the same size, which shoves forward and through the opening just enough matches to fill the box which is held to the opening. Three girls work at each box-filling machine; one fills the boxes, the other two close them. They fill on an average of 20,000 boxes in eleven hours, and each makes about 70 cents a day. In filling boxes by hand the girls become so expert that they can take up the exact number of matches required each time.

With the exception that neither sulphur nor phosphorus is used for tipping matches, the process in Sweden is about the same as *it* is in France. The Swedish matches are "safety" matches that can only be lighted when scratched on a prepared surface, and the tipping compound is a paste of chlorate of potash. The igniting surface, which is placed on both sides of the match box, is a paste, of which sulphide of antimony and red phosphorus are the principal ingredients. This paste is laid on the sides of the boxes by a machine, which passes the boxes between two rollers that are charged with paste. As the procession of boxes moves between the rollers they spread the paste evenly on the sides, and then the boxes are laid away until the paste is dry.

A long, cool, dry room is required in the manufacture of wax matches. The splints are made of cotton thread, covered with stearine or paraffin. The wax match is a miniature candle, and its little wick is made of from ten to twenty threads, depending on the thickness of the match. This cotton wick is wound in large balls, held on reels at one end of a long room.

The paraffin is melted in a long bath and portions of it are dipped out and placed in small pans, through which the thread is conducted. The wax-coated thread passes from the first pan of paraffin through a steel die, which scrapes off the excess of wax and prepares it for the second coat. From this pan the twice-coated thread passes through a steel die, in which the hole is slightly larger than the first, and the third and last pan has a die which gives the waxed thread the proper diameter. Then the paraffin-covered wick is taken to a large drum at the far end of the room, on which it is slowly wound.

As the wick hangs in the air in going from the last pan to the winding drum, the paraffin cools and is quite solid when it reaches the drum. If the wick is not coated sufficiently the drum is taken to the end of the room in which the reels stand, and another coating of wax is put on. The wick is cut to match lengths in a cutting machine, and then the wax splints are dipped in the lighting compound.

Matches that will burn in spite of rain and wind are called "fusees." The splints are dyed blue by boiling them for several minutes in a composition, and then they are dipped. The burning composition is a mixture of potash and ground sawdust, and this thick paste is put on the splints in three dipping operations, which give the match head a pear shape. The igniting compound can only be fired by rubbing it on a prepared surface, similar to that used for safety matches.

In fact, the fusee is but a safety match, with a knob of ground sawdust and potash. The inflammable tip ignites this composition, which sizzles and sparkles for a number of seconds, no matter how much it is exposed to the wind. These matches are packed in boxes by hand, for the shape of the head makes it difficult for machinery to do this work. All of the wooden splints of safety and inextinguishable matches are paraffined, so that the wood is rendered more inflammable.

The French government pensions its matchmakers after thirty years of service. The pensions for men average about $120 a year and for women $80. And it also pays the surgeons who operate upon victims of necrosis, caused by the white phosphorus used.

VENEERS FOR FINE FURNITURE

It would surprise the average man to know how little of the genuine there is in modern furniture. Not all is mahogany that is sold as such, and the "solid" oak frequently is two-thirds basswood. Since the days of Pliny veneers have been used to give a handsome and costly exterior to cheap insides, and to-day veneers are used more generally than ever before, and their use is steadily increasing. Manufacturers say that because a piece of furniture is veneered is nothing against it; that as a matter of fact veneered goods have an advantage over the solid. They neither warp nor check, and the matter of cost is an important factor to the man of small means and large desires in the furniture way.

A bedroom set of solid mahogany would cost a small fortune, and with all of its cost it would not be as handsome to look upon as one in which veneers are used. Veneer cutting has been reduced to a science, and by modern methods effects in grain and figure are secured which the ancients never dreamed of, and which cannot be produced by the most ingenious straight sawing.

Properly speaking, a veneer is a thin sheet of wood to lay upon a cheaper material to give it the appearance of the more costly. Wood is cut thin to be used in the manufacture of berry boxes, baskets, casks and other commodities, but the veneer cutter does not regard the producer of berry boxes as belonging to his class, any more than the cabinetmaker looks upon the carpenter as one of his craft simply because they use certain tools in common.

New York is the great veneer-producing center of the country, and then come in the order of importance Boston, Grand Rapids, Cincinnati and Chicago, with a few scattering producers at other points. Mahogany, the king, queen and whole royal family of the cabinet woods, leads the list of material most used for veneers. Other for-strips rapidly widen as the cutting progresses, until they are the width of the semicircle described, with the outside as a center. In the same way the width decreases until it is but five or six inches, and nothing but the core is left.

It is in this manner that the beautiful tree and fountain effects are obtained in mahogany and walnut, effects that can never be obtained by sawing or round cutting. The greatest care, experience and closest attention are necessary to get out of a log what there is in it of beauty and value.

The veneer cut from a log by the reverse roll process is kept by itself through all subsequent operations, as the veneers are similar in color and approximately so in figure, so that matching to get the required width is easy. The ordinary roll veneers are run from the machine to a saw, which cuts them to dimensions required for panels and other uses.

From the saw or from the cutter the veneers are sent to the dry kiln to be thoroughly and carefully cured. Veneer is sold by the square foot and goes into many channels of trade. It is used by piano makers and car builders, and enormous quantities are consumed by furniture manufacturers. Much of it is used in interior finishing of houses. Usually the veneers are put on the pianos, cars, furniture, etc., by the manufacturers who buy them, but often, and especially for panels for desks and table tops, all of the work excepting adjusting, finishing and polishing is done at the veneer factory.

The usual base for veneers is basswood. This is cut on the roll cutter to a thickness which varies with the requirements, from an eighth to three-eighths of an inch. The foundation for the costly coating is built up, usually three-ply. The center is three-eighths of an inch in thickness and is cut to the desired dimensions for the panel.

It is run through a machine which resembles in looks a laundryman's mangle, where it is covered on both sides with glue. As the pieces come from the machine they are laid in a pile, with the eighth-inch pieces above and below, laid with the grain at right angles to the grain of the center piece. When the pile is high enough it is trucked away to the press, where, under heavy pressure, it remains until thoroughly dry.

The veneer is usually applied in the same way, the base having been run through the gluing machine, but greater care is observed in adjusting the surface pieces and handling it. The figured veneers are always matched by expert workmen and the pieces that go together to produce the best effects are fastened together with strips of paper, and then, for convenience in handling, are folded.

For rough work—baskets, berry boxes, drawer bottoms, backings and similar stuff—the ordinary lathe is used to cut the veneers, and the thickness varies from an eighth to three-eighths of an inch. The woods most cut for such purposes are basswood, maple, elm, birch, poplar and white wood. The largest producing section of country in the world for this product is northern Michigan, where hardwood is abundant and cheap.

GRAPHITE AND LEAD PENCILS

The "leads" of lead pencils are made of a mixture of German pipe clay and black lead, which is not lead but graphite. But rst pencils were made of real lead, he name has clung to them ever since.

IN A CEYLON GRAPHITE MINE.

Graphite or plumbago is a nearly pure form of carbon. In this respect it is a brother of the diamond and a half-brother of coal, lampblack and several other dissimilar substances. But unlike coal and other forms of carbon, graphite will not burn. It is so refractory that it withstands the most intense heat that a furnace can give. Diamond, a pure carbon, is the hardest known substance. Graphite, a pure carbon, is one of the softest, if not the softest, of minerals dug from the earth. Yet a diamond can be reduced by intense heat to a cinder, while the block of graphite on which the diamond rests will not have its sharpest edge dulled by the fire.

Graphite is found in its natural state singularly pure. That taken from the Ticonderoga mines, the most important in the United States, has been found 99.9 per cent pure. It is found in irregular sheets or detached masses, with every evidence that it is the result of destructive distillation of vegetable or animal tissue. It i supposed that graphite, like coal, originall was vegetable matter, which was tran formed to its present form by immer pressure and intense heat. But why should withstand heat, and why coal wh came from the same source and through same processes, should burn, is a m that science has not settled to the sati tion of investigators.

Ceylon furnishes a large part c world's supply of graphite. Most graphite from Ceylon is taken to E for distribution and manufacture. country it is found in many places New York, California, Massachuse mont and New Hampshire it is m mercially.

The graphite is taken in the l the mines and carried to the red where it is ground or pulverize mills under water. The fine particles of the graphite flow away with the water through a number of tanks, collecting at the bottom of these reservoirs. It is packed in barrels and sent to the factory, where tens of thousands of lead pencils are turned out every day.

The pulverized graphite is so fine that it powder for the finest pencils settling in the last tank. In another series of tanks the German pipe clay which is mixed with graphite to secure the different grades of pencils, from very soft to extra hard, is graded in the same way by floating. The finest clay is mixed with the finest graphite, and the hardness of the pencil is secured by

SORTING AND SIFTING GRAPHITE IN CEYLON.

really is a dust, dingy in color and smooth and oily to the touch. It is divided into various grades of fineness, by floating on the water from one tank to another. The coarse dust sinks to the bottom of the first tank, the next finer to the bottom of the second, and so on down the line, the finest increasing the proportion of clay in the mixture. For the medium grades, seven parts by weight of clay are mixed with ten parts of graphite.

After the graphite and clay are ground together in water the mixture is put in canvas bags, and the water is squeezed out under the hydraulic press, leaving a mass like putty. This plastic material is placed in the forming press, which is a small iron cylinder, in which a solid plunger or piston works up and down. A steel blade having a hole the size and shape of the lead in the pencil, is put under the open end of the cylinder, and a plunger, pressing down, forces the graphite through the hole, making a continuous thread or wire of it. As long as this thread is moist it is pliable, but it becomes brittle when dry, so it is handled rapidly. It is cut into three-lead lengths, straightened out, and then hardened in a crucible over a coal fire. The leads when taken from the crucible are ready for the wood.

Pine is used for the cheap pencils, an ordinary quality of red cedar is used for the medium-priced pencils, but nothing but the best Florida Key cedar is put into the best pencils. The saw mills in Florida cut the cedar into blocks about seven inches long, and these are sawed into strips wide enough for six pencils. But as pencils are made in halves, each strip is only thick enough for half a pencil. When the strips are received at the factory, they are run through a machine which cuts in each one six grooves, round or square, and at the same time smooths the face of the wood. Both strips are grooved alike, for, unlike the European-made pencils, those made in America have the lead equally in each strip.

The filling of the strips is done by girls. The first one takes a grooved slip of wood in her left hand, and a bunch of leads in the right. She spreads the leads out in a fan shape, and with one motion fills the six grooves with leads. Next to her sits another girl who takes the filled strip, and quickly and neatly lays on it another grooved strip, which has just been coated with hot glue by a third girl. The filled and glued strips are piled up together and put into a press, where they are left to dry. The ends of the strips are evened off under a sandpaper wheel, and then the strips are fed into a machine which cuts out the individual pencils, shapes them and delivers them, smooth and ready for the color and polish, in six streams. The coloring is done in liquid dyes, after which the pencils are sent through the varnishing machine. Then follow the stamping and finishing, all done by automatic machines, and finally the finished pencils are packed around the oval grooved blocks, tied and wrapped ready for shipment.

The pencils are counted at various stages of the making, and the counting is done in a way as simple as it is accurate. The counting board is a board on which two strips of wood are fastened the length of the board, about four inches apart. In each strip are 144 grooves. The workman grasps a handful of pencils and rubs them over the board once or twice, leaving a pencil in each groove. In this way he counts a gross of pencils in a few seconds, and does it without a mistake, for only 144 pencils can be placed on the board at one time, and if any grooves are empty the workman notices the mistake at once.

Graphite is also used in large quantities as a lubricant for the chains of bicycles, and another important use is in coating molds in electrotyping. Crucibles for chemical and other purposes, where intense heat is required, are made of graphite mixed with fire clay and a little charcoal, and then molded while moist, as pottery is made.

HOW RUBBER GOODS ARE MADE

When a man throws his worn-out overshoes into the alley he has an idea that their days of usefulness are over. But there is where he is mistaken. The rag-pickers and rubbish-gatherers rescue the overshoes out of the garbage box and sell them to the man who makes more money buying waste material than some do in corner lots or deals on the board of trade. This man sends the old, worn-out footgear which has india rubber in it to the india rubber factory, and there the old shoes are worked up into garden hose, wagon springs, door mats, belting and a hundred other things turned out of india rubber.

Pure rubber has its limitations in the industrial arts; it is too soft, too stretchy and has not enough "body" and general toughness to withstand the wear and tear to which overshoes, doormats and garden hose are subjected. Then again the rubber is too costly to be put in its pure shape into many of the everyday articles which are classed as india rubber goods, so the manufacturer mixes in rubber which has seen service with the pure Para gum, and makes it into the thousand and one things which are regarded as indispensable by machinists, electricians, workmen in all trades, and, in short, every person in the civilized world. By mixing old rubber, mineral earths and other substances with the pure gum the manufacturer is able to produce an article which he can sell at 17 cents a pound or less, when the pure gum is selling for 65 cents a pound or more.

The best india rubber comes from Brazil, and the best of that from the upper Amazon river, and this is the "fine Para" of commerce. It is sent to the factories in the United States in the shape of irregular lumps known as "bisquits," and these bisquits are made by the "seringueiros," the rubber-gatherers of Brazil.

The seringueiro starts out with his little tomahawk about eight o'clock in the morning, for if he plunged at an earlier hour into the rank undergrowth of the forest in which the rubber tree grows, the heavy dew would soak him through in a few minutes. With his tomahawk in hand he goes from one rubber tree to another, cutting little gashes in the bark, and fastening under the cuts small tin or clay cups, not much larger than teacups. He "blazes" the tree until noon, when he retraces his steps and finds that the cups are filled with the milk-white sap which has dripped from the wounds he made in the bark.

The sap is poured into a basin-like vessel and taken to the hut where the gum is to be cured. This is done by smoking the gum over a queer furnace shaped like an inverted vase, under which are burned the nuts of the urucary, a species of palm. The nuts make a dense smoke, which pours out of the neck of the furnace. The workman, squatting beside the fire, dips into the rubber sap a wooden paddle, to which clings a thin layer of the sticky juice. Then the gum-smeared paddle is held and turned in the smoke until the water in the sap evaporates, when the paddle is dipped into the sap again. This operation is repeated until the gum forms a large lump on the paddle about the size of a man's head. This is cut from the wood, and after the "bisquit," as the ball of gum is called, has been exposed to the sun for a time, to complete the drying, it is piled up with the other bisquits and shipped away.

The india rubber manufacturer first

cleans the rubber, for bits of leaves, pieces of bark, earth, stones and other foreign substances are mixed with it in the bisquit, so the bisquit is put in the "washing machine." This is composed of a pair of toothed rollers, over which a perforated water-pipe hangs. The crude rubber is cut, squeezed and mashed between the rollers, and a spray of water carries off the impurities. The rubber comes from the washing machine in irregular strips, rough as bark and resembling somewhat the old slabs of lumber which are piled up outside a sawmill. The "mixing" machine, to which the rubber is taken next, is not unlike the washing machine, for it has a pair of steel rollers, and over them is a box or hopper filled with the compound which the rubber-maker mixes with the pure rubber. It is at this stage of the manufacture that the old overshoes, arctics, garden hose and other worn-out goods begin life again.

In the compound also is the sulphur, in one form or another, which "vulcanizes" the rubber, and which gives to manufactured rubber those preservative qualities the absence of which prevented rubber from entering into the industrial arts until it was discovered that sulphur was the substance the chemists had long been looking for. The washed rubber mechanically combines with the composition in the mixing machine, and it is then either taken to the rolls, where the rubber is coated on canvas, or else to a machine which kneads the rubber preparatory to pressing it into molds. At no stage of the process is the rubber ever melted. It is warmed up at times, but molded solid rubber goods are pressed into molds, not poured in.

A large proportion of rubber goods ought to be called rubber-clad goods, for they are made from duck or canvas of different weights, coated with rubber, and this is done in the frictioning machine, which consists of iron and steel rolls placed one over the other, in which the duck and rubber are pressed together. As the duck passes between the rollers, the sheet of rubber laid on top is pressed into the duck, and the pressure is so great that the duck and rubber become almost one material. This rubber-clad duck is the basic fabric from which garden, fire-engine, steam and other hose, belting, packing, gaskets and other rubber goods of like character are made. Hose is made in fifty-foot lengths, from two to ten ply, and it is all made on iron mandrels, or rods, which are of the same size as the inside diameter of the hose.

A strip of pure rubber fifty feet long and just wide enough to double around the mandrel is first wrapped around the iron rod, and as the fresh-cut edges are touched with naphtha, the rubber unites and forms a pure rubber pipe, which is afterwards the inside of the hose. The rubber-coated duck is next wrapped around the pure rubber pipe, which is still on the mandrel; if the duck is wrapped around twice the hose is two-ply, if four times the hose is four-ply. The duck is wrapped around the mandrel by machinery, and small rollers press the edge of the duck, so that every inch is subject to pressure. Then another strip of pure rubber is put around the duck for the outside, and the hose, still on the mandrel, is put in the "heater." This is nothing more nor less than a gigantic boiler, fifty-five feet long or longer. Steam under pressure is admitted to the heater, and the sulphur in the compound becomes chemically united with the rubber and the rubber is "vulcanized." The hose is kept in the heater from

-half to three-quarters of an hour, and en it is taken from the mandrel. Its gged ends are neatly cut, and it is ready receive the brass fittings. In stripping he hose from the mandrel compressed air s used. The air is admitted between the hose and the mandrel, and the hose, expanded by the air, slips off easily.

Rubber belting for machine shops and factories is made from the rubber-coated duck, and it, too, is made up into two-ply, three-ply, and up to ten-ply, depending on the number of times the long strip of duck is folded upon itself. When it is folded up, however, it is not cured in the heater, but in a long hydraulic press which squeezes the folds of the rubber-coated duck until the several layers of canvas and rubber are practically one solid piece. At the same time steam is introduced to complete the vulcanizing process, and make the adhesion better and the union stronger. The belting is pressed in sections, as the press is not long enough to take in an entire length of belting, and each section is under pressure from twenty minutes to half an hour.

Rubber bands sold by stationers and used by millions in offices and stores are cut from a pure rubber hose which is placed on a mandrel in a lathe. As it revolves a knife cuts off the sections of the hose, and these narrow sections are the rubber bands.

The large perforated rubber mats which cover the floors of halls and rotundas in business blocks are cut out by hand. The thick rubber sheet is laid on a block and with different-shaped dies the pattern is punched out. In this way it is easy for the manufacturer to make rubber mats to order and from special designs, with the name of the company or firm in the center of the mats.

BARRELS AND KEGS

When Pliny, who was born 23 A. D., took his first trip into the Alps, he was surprised to find the natives using casks and barrels. The discovery made such a deep impression on him that he made a note of his find, and, when he returned to Rome put the discovery into words which have descended to this age. The Romans, learning of the novel vessels used to store wine and liquids, went into the mountains and soon mastered the cooper's art as it existed in those days. They improved on the rough casks made by the mountaineers, and before many years were turning out a better product. Pliny did not fully describe those first barrels, or if he did the description was lost, for history has not disclosed what early barrels and casks were like. It is supposed that they were rough, crude, bungling affairs, with leather thongs for hoops and rough hewn logs for staves. After Pliny's time tight casks came into general use among the Romans, who spread them through the known world.

Flour, apple and other barrels made to contain solids are of more recent date. But a short time ago, flour was sent abroad in white sacks, which were inclosed in heavier ones. It rarely happens now that flour is exported in sacks, for barrels have taken their place because modern methods of production have reduced the cost of flour barrels until it is cheaper to use them instea of sacks, and barrels are much safer i every way.

The manufacture of flour barrels h grown to be an industry by itself. It is d ficult to estimate how many are made e year in the entire country, but it is a g many millions. Minneapolis ann turns out between 2,500,000 and 2,750,000 flour barrels, with Kansas City, West Superior, Chicago, Milwaukee, Buffalo, and many other cities important contributors to the total annual output.

According to the most modern and approved method, it requires eight men to turn out a complete barrel. The work is done by the piece and each man performs his allotted share and passes it on to the next. The cooper has not been entirely discarded, for he does a small proportion of the labor, such as hooping the barrel and finishing it ready for the miller. Machinery does the rest.

Staves are of elm, taken from the hardwood forests of Minnesota, Wisconsin and Michigan. The stave factory is located in the heart of the woods, for the sake of convenience and also as a matter of economy. When it is received at the city cooper shop, the stave is a flat board three-eighths of an inch in thickness, narrowing toward each end, so that it will draw into the shape of a barrel when set up. It was formerly the custom to use hickory hoops. Then those made of wire were tried; but each in turn has had to give way, and now a hoop made of elm is in general use throughout the country. The latter has been found more durable, stronger and cheaper.

The "setting up" apparatus is extremely simple. Near the workman is a large pile of the staves corded into bundles. It requires seventeen staves for each barrel, and they are inserted in a circle between an iron "truss hoop" and the "form." Another truss hoop is drawn on, usually a wooden one, and the next workman takes the barrel. The upper ends are sticking out in every direction, and it is his business to bend them into shape. He is the "windlasser." A wire rope, working on opposing eccentrics, alternately tightens and loosens, the motion being continuous. The skilled workman places the irregular end of the barrel into the loose loop, and when the coil tightens the staves are brought into place. A couple of wooden truss-hoops are slipped over the center, and an iron one is placed on the drawn end. The barrel is rapidly beginning to assume shape, but, as yet, there are no heads or chimes or permanent hoops.


MAKING FLOUR BARRELS.

The next step is to the heater. A small

sheet-iron stove, just large enough to fit the interior of the barrel, has been made red hot by a rapidly blazing pine fire. The barrel is placed over this and allowed to remain until the staves are thoroughly dry, and they fit as closely as it is possible to bring them together. The heat also gives the flare or bulge to the center of the barrel.

The "tapper" takes the barrel, and with his cooper's adze taps the staves from the inside until they present a smooth appearance and none of them bulge at the joints. He generally places one or two extra truss-hoops on the barrel before commencing his work. The two following steps are purely mechanical ones. The barrel goes into the "trusser," a machine which presses it together, driving down the truss hoops to keep it in place. Then it goes to the "working-off" machine, where the "croze" and the "chime" are worked on it. A workman then dexterously knocks off the two iron truss-hoops and it is ready for the cooper, who adds the finishing touches.

The cooper is equipped with an adze, a sharp spoke-shave, a hoop vise, a wooden driver, and one or two other tools of minor importance. When the barrel reaches him the staves are held in place by three wooden truss-hoops but it contains no heads. In the technical language of the shop there are no bottoms; everything is head.

The heading is put in place, then the cooper measures the hoop on the barrel, putting it in a vise and nailing the ends together with a copper staple, adding three small nails. The hoops are then "driven" into place, there being eight to a barrel. If the working-off machine has not done its work completely, the cooper supplements its efforts by running over the side with a sharp spoke-shave. The barrel is then ready for the mill, and in a few hours it is filled with flour, ready for shipment.

When a cooper shop is run with any degree of system the output for the day represents a good many barrels. Eighty men, sixty of whom are coopers, the other twenty operating the mechanical department, can produce 4,000 barrels during a run of ten hours. If each individual were required to make a complete barrel without the aid of machinery the output for the same number of workmen would be reduced to less than a thousand.

A cooper receives from $2.50 to $3.50 a day at piece work, while employes in the mechanical department are paid from $1.50 to $4 a day, according to their duties. It is quite universally conceded among coopers that the machinery of to-day is doing the maximum of work compatible with a finished and substantial product.

Paper barrels and barrels made of broad sheets or thick veneers of wood, compete with barrels made of wooden staves for storing and transporting dry stuff. The paper barrel is made from a single sheet of strawboard, curved to a cylindrical shape and held together with metal fasteners, or it is made without a joint by a machine which by centrifugal motion throws the soft pape stuff against a mold. A steel barrel fo holding oil has been put on the market, an barrels made from wood pulp chemical treated have been made.

The importance of the cooperage tr is demonstrated by the number of kegs u for the single purpose of holding beer. one brewery in Milwaukee more t 12,000 kegs pass through the establishı each day, and that brewery turns out than 1,000,000 barrels of beer annually. Add to the brewing industry flour mills, nail mills, distilleries, pork packers, sugar refineries, fruit growers, paint mills, varnish works, salt works, lime and cement works and a thousand and one other industries that use barrels, casks, kegs and hogsheads by the hundreds of thousands, and some idea of the vast number of hooped vessels turned out by the cooper each year can be arrived at.

SEEDS AND HOW TO TEST THEM

When spring begins to draw near, heralded by alluring and highly colored advertisements of seed dealers and florists, the farmer, housewife and amateur gardener flood the mails with the seed orders they are sending to the dealers. The little paper packages, full of promises of lovely blooms and plump vegetables, are sent by return mail, and then come the planting, waiting, anxiety and triumph or disappointment. Those who buy their seeds of reputable, conscientious dealers have themselves to blame if plants, grasses, flowers and shrubs fail to spring from the seed; but too often the little bags or packages of seeds contain sand, crushed quartz, "dead" seed, or inferior seed mixed with a small proportion of the genuine, for seed adulteration has been reduced to a science.

Sometimes this adulteration is due to sheer carelessness on the part of growers and dealers, but more often it is the result of careful study and skillful manipulation by dishonest men. Europe set the example of mixing inferior, dead and cheap seed with the good, to increase the profits of the grower and dealer, and some of the worst pests which trouble farmers were introduced into this country through the medium of adulterated seeds. The Russian thistle, a foul weed which covers over 35,000 square miles of good farming lands and seriously interferes with agricultural operations in seven states, stole into the United States more than a score of years ago in Russian flaxseed.

It is said that the average farmer buys the cheapest seed in the market and trusts to luck for results. This practice is condemned by experts, who declare that cheap seed is the principal source of the hosts of noxious weeds which spring up on many farms. Purity is a primary requisite to good seed, and adulterated seed is not pure. The adulterating matter may be worthless, harmless stuff, such as sand, dirt, stones, crushed quartz or dead seed, or it may be seed of harmful weeds, which so nearly resembles the genuine that the closest inspection fails to discover the fraud.

Grass and clover seed are the principal victims of the dishonest "mixer." A common method of adulteration is to mix the seed of wild and inferior grasses with that which commands a high price. A grass seed which sells for 12 cents a pound will be mixed with seed worth 20 cents, and the mixture will be sold at the top price, and under the name of the 20-cent seed. Some sample packages of seed labeled "Kentucky blue grass" were examined in one instance, and it was found that 35 per cent of it was made up of weed seed, dirt and chaff. A pound of "orchard-grass" seed in a package that was examined, contained 1,400 seeds of the sheep sorrel, a worthless weed. Nearly 100 samples of clover seed, bought of dealers scattered over the country, showed adulterations ranging from three ounces to forty pounds a bushel.

nifying glass to aid in separating the impurities from the sample to be tested, any farmer can ascertain the practical value of his seed. The sample should be a fair average of the whole, and it should be weighed and the seeds counted so that the proper percentage of purity and germinating value can be ascertained accurately.

For cleaning large quantities of seed from which to secure a test sample, a seed-cleaning machine is required. One used in an experimental station is like a fanning mill. This machine not only separates the chaff and dirt from the seed, but divides the cleaned seed into light and heavy seeds. All that this machine does can be done by a farmer with a number of sieves, varying in the number of meshes to the inch. With a number of such sieves the seed can be cleaned and separated quickly and cheaply.

EGGS AND HOW THEY ARE INSPECTED

Christopher Columbus had to smash an egg to make it stand upright. The men who inspect eggs could have shown the great discoverer how to make history without breaking eggs, for, by a twist of the wrist and a shake of the elbow, they toss eggs from one hand to another, lift them out of cases by the handful, finger the fragile things with a sleight-of-hand dexterity which is astonishing, and can make an egg balance itself on the edge of a case without even nicking the shell.

In the early days of the trade these jugglers of eggs were called "egg candlers," because the lowly tallow dip supplied the rays which betrayed the interior economy of the product of hens' nests. But the development of the industry and the adoption of the electric incandescent lamp for the light brought about a change of name, and the members of the craft are known as "egg inspectors."

A good brisk inspector, handling a fair run of eggs, can "candle" thirty cases of eggs a day; as each case holds thirty dozen, the day's run will average 10,800 eggs. The work is carried on in a dark room, in which the only lights are those used for inspecting the eggs. The condition of an egg is found by holding it to the light, and the degree of the translucency, color, spots and shape of the dark places determines the grade and character of the egg.

In Chicago and all large centers which have the electric light the incandescent lamp is used. But the candle by no means is laid on the shelf. Many inspectors claim that the incandescent light hurts their eyes, and that candle light is best after all, even though its modest flame flickers and sputters when the nimble fingers of the candler stir the air about it. The candle usually is held upright between three shingle nails stuck in the end of a short board, and the inspector holds the eggs close to and slightly above the flame, so that he looks down upon it.

Gas jets are used in some places and "natural" light is employed in others. When sunlight or daylight is used the window is completely covered except a space about four inches long and two inches wide. This opening is covered with leather and in it are two holes. The eggs are held up to the holes and "candled." The bulb of the incandescent light is enveloped in a sheet-iron hood, which has a small opening in the front part. The eggs are held up to this opening, two at a time, and inspected.

Any man can candle eggs if he "knows eggs," for the handicraft consists simply in holding the egg to the light, looking through it and classifying it according to its appearance. But—and the "but" is a large one—the man who inspects eggs must be able to distinguish at one glance the particular class to which the egg belongs, and egg inspectors recognize twenty grades. A clever man with a keen eye, a nice sense of discrimination, an adhesive memory and a well-developed knack of handling things may become a fair egg inspector in three years, but five years probably will pass before he is expert enough to go on the list of adepts.

The handling of the eggs is an important factor in the craft. Any man can pick up a single egg, hold it to the light, turn it round two or three times and lay the egg back in the crate again, but it takes an expert to pick up four eggs in one hand, three in another and by the mere working of the fingers roll an egg between the thumb and two fingers and then roll it out of the way to put another one in its place. Generally two eggs are picked up with each hand at a time, so that they are inspected in groups of four.

But the inspector does more than candle his wares, for he handles his own cases, lifts them to the bench, takes them down again, nails on covers, transfers eggs from one case to another and tells of marvelous curiosities in the egg line, which have passed under his fingers. He mentions three-yolk eggs; double eggs in which a perfectly formed egg, shell and all, is found inside of an egg; eggs with all of the colors of the rainbow in their shells; eggs with words and dates formed in the shell, and eggs with double and triple shells.

One of the many interesting "tricks" done by the men who earn their bread handling eggs, is that of transferring them from one case to another. Eggs are shipped and stored in cases, and are packed in strawboard compartments or "fillers," each of which is a tray and holds three dozen eggs.

A square sheet of strawboard lies under each filler. The inspector slips his hand

"CANDLING," OR INSPECTING EGGS.

under this sheet of cardboard and with his other hand on top of the tray lifts it, with its load of thirty-six eggs, out of the case, lays it over the empty filler and withdrawing the cardboard allows the eggs in the top tray to fall down into the empty one. This is a knack of the trade which requires but a trial by a layman to prove its elusive nature.

A strictly "fresh" egg is one without flaws of any kind. It may be ten days or two weeks old, but it is not more aged. This is called a "selected" egg and commands the highest price. When eggs begin to ow stale the white shrinks, and this is ıown to the inspector by a well-defined ne in the large end of the egg. If shrunk oo much for the first class, the egg goes nto the "seconds," which also include fresh eggs that are "checked" or cracked.

A checked egg is a cracked egg, but the crack is not noticed until it is held up to the light or is rattled or "ticked" in the hand with another egg. A solid egg-shell gives a clear sound if ticked against another egg, but a cracked or checked egg gives out a dead, wooden sound. After the seconds come "spots" and "leaks." "Spots" are eggs in which the yolk clings to the shell and "leaks" are broken eggs. These are the general grades, but each of them is subdivided into grades recognized by the trade.

The best eggs are selected to be placed in cold storage warehouses from which they will be taken and sold when fresh eggs are scarce. They are carefully inspected before they are sent to the icehouse or cooler, and most of the inspectors are on this work in April and May, and sometimes the early part of June. During this period the hen is working overtime and sending fresh eggs to market; then she takes it easy for a time.

Eggs are kept in cold storage for seven, eight or more months. For the first three months they retain their original flavor and then they begin to deteriorate, and the longer they are kept the staler they become. When withdrawn they are inspected as though they were fresh eggs, and divided into similar grades. Pickled eggs are those kept in some lime or alkali solution, and salted eggs are preserved by being packed in salt. Of course, none of these preserved *eggs* is as good as the fresh article, but if they pass the candler they are good enough to eat.

The inspector can detect preserved eggs at once and also can name the "icehouse," "pickled" or "salted" egg when it comes up. The icehouse egg is shrunk, its yolk is dark and it has a dull ring when ticked. The shell of a pickled egg is mottled and gives a metallic sound and the yolk is dark, and a salt egg has a shell which looks as though the salt had eaten into it. A pickled egg is apt to burst when boiled, for the lime fills up the pores so that the steam is confined.

A "blood-egg" is bright red when held to the light. In "yellow rot" the white and yolk solidify together and the egg shows yellowish red. A "watery egg" has an air bubble which floats on top, no matter how the egg is held. A "green" egg is pale before the light and shows a dark yolk. When broken the yolk is seen to be a dirty green in color. A frozen egg shows a crack reaching from one end to the other, and a double-yolk egg has two cloudy spots which swim round inside when the egg is turned, and a rotten egg is dense black before the light.

This is the way an egg inspector stands an egg on its point. He finds one that is somewhat "gone." Such an egg has a well-marked bubble or spot in the top. Holdin the egg point down the inspector jerks i downward several times, so as to drive th heavier portion to the small end. Th he carefully balances it, and the egg stan up, straight as a soldier.

MINCE-MEAT MADE BY MACHINERY

Mince pie is Uncle Sam's national sert. A celebrated Englishman who visited this country apostrophized "the incarnation and quintessence of American independence." The British have their tart, and the French their paté—both undoubtedly the works of genius in their way —but it remained for the Yankee to rise above the traditions of the past and conceive the idea of rolling the favorite desserts of both nations into one, adding a sprinkling of spice and a dash of cider, and inventing the expressive name "mince pie" for his creation. Unfortunately history does not record the name of the grandmother who first mixed mince-meat—she is one of the unlaureled and unsung benefactors of the human race. Yet as she sneezed over the nutmegs for the first pie, she may have seen, dimly, through the long vista of the future, the scrambling crowds of men and women around the "hot-mince" table at the "help yourself" restaurant. If she did, she had her reward.

But mince-meat making, for a long time the secret craft of the grandmother, has been reduced to a science, and mince-meat is now being made throughout the country in quantities to supply every man, woman and child in the United States with a pie a week all the year round. Besides a considerable number of pies are shipped over to England and France, where the former devotees of those inferior creations, the tart and the paté, are wondering vainly and enviously how the pies were made. When first exported, a French chef who has since become famous, invented a new kind of fruit cake or plum pudding, which was the delight of every epicurean palate and the despair and torment of all the rival cooks of Paris, who could not imitate the marvelous creation. But it was only mince-meat, just like mother used to make.

In the early stages of its evolution mince-meat was no higher in the scale of culinary progress than ordinary hash. It was doubtless the outgrowth of the Yankee housewife's "nearness." She had some scraps of meat left and some extra apples, so she chopped them up together and made them into a pie. Out of such humble beginnings mince-meat forced itself upward by sheer merit, until it stands shoulder to shoulder with apple pie.

At first mince-meat was made soft and juicy, and it had to be kept in a cool place in the cellar where it would not spoil. But there was a far sighted man named Allen who saw that it had a glorious future, and so he went to work studying its characteristics. After a while he found that it could be condensed in dry form so that it would outlast a piece of wedding cake. With the invention as a basis, a number of large manufacturing concerns have sprung up, several of which are located in Chicago.

The beef used in making mince-meat comes from the shoulder of the animal, and is cut in lean strips. It is taken at once in big trucks to the mince-meat factory, where it is thrown into a vat, in the bottom of which there is a coil of steam pipes covered with water. Here it boils away, stirred from time to time by a brawny workman, until the blood is all cooked out of the fibers. The room in which the work is done always has a rich, almost dinner-time odor. When the master workman thinks the cooking has gone far enough the meat is forked out and taken to the chopping-machine. This has a big basin which can be made to revolve slowly. At the center of it a shaft, to which are attached a number of knives, jumps up and down and cuts the meat, very much as a woman would cut it with a chopping-knife.

When it is fine enough the "batch" of 500 pounds of mince-meat is laid aside.

Dried apples are used, the finest grade that can be obtained in Michigan or New York. About 500 pounds of them, or a quarter of the future "batch" of mince-meat, are chopped in a machine similar to that used for the meat. When they are fine enough the workmen trundle them off to the mixing-room.

A small apartment opening from the chopping-room contains the spice mills. A great number of bags and barrels are standing at one side of the room and on the other side two machines, which resemble big coffee mills, are droning pleasantly. When the spices come in they are first ground in the mills to a fine powder and then placed separately in barrels. There are allspice, cinnamon, mace, citron, nutmeg, cloves, ginger and a very little pepper. The workman mixes them in just the right proportions, about fifty pounds of them being necessary to properly season a 2,000-pound "batch" of mince-meat.

The currants and raisins come in boxes, and before they can be used they have to be thoroughly picked over and cleaned. This is accomplished by pouring them on a fine meshed sieve through which all the particles of dust and the little pieces of stem will sift.

Now the ingredients are ready for mixing. The meat is poured into the bottom of a long, narrow trough standing on the floor, the apples go in on top of it, then the raisins and currants and the spices and the sugar. A few gallons of New York State cider are poured over the mass, and then half a dozen big, bare-armed men with shovels begin to turn over and mix the *fragrant mass.* When the mixing is complete, the mince-meat is shoveled out into a truck, where it is allowed to stand several hours. It is almost dry and is rich and tempting.

The packing-room is full of animation. Around a long table stand a score or more of girls in white caps and aprons. Before each of them there is a pair of iron rods, crooked at the end and standing upright in the table. By a motion of the foot the girl can force the rod down until the crooked ends slide into two little boxes, just as a pumpdasher slides down into a pump. The mince-meat is placed on a traveling belt which runs along the table and the girls take it in handfuls and pack it into the little boxes before them. Then the rods come whirring down and compress it into a solid block hardly larger than a cake of stove blacking. This block weighs twelve ounces and will make three pies. It is passed along to a girl who wraps it up in oiled paper and slides it into a little pasteboard box, after which it is ready for shipment.

About 15,000,000 pounds of mince-meat are made annually in the United States, and it is consumed largely in the big cities the country housewife still preferring t follow in the footsteps of her grandmothe and make her own mince-meat.

BUTTERINE AND OLEOMARGARINI

While the Prussians were encam around Paris during the siege of 187(the Frenchmen inside of the beleaguere awoke one morning to find that they v have to eat their bread without any b It was one of the first intimations th supply of provisions was running and it lent color to the fears already expressed that the city would be conquered as much by starvation as by the Prussians.

One by one other commodities disappeared from the stalls and markets, and the prices rose higher and higher. Yet a few days before the capitulation a sign appeared in the market place advertising butter for sale, and although there was a rush to purchase, the supply seemed inexhaustible. At first the street throngs thought that some avenue had been opened through the Prussian ranks for the transportation of food, and the joyful rumor quickly spread over the city. But the butter had not come through the lines. An ingenious inventor named Mege Mouries, spurred on by want and necessity on every hand, had made it in a Paris factory. That was the beginning of the oleomargarine or butterine industry.

The French found that the new compound was not only good to eat, but cheap and wholesome, and since that time the manufacture has grown immensely and the capital invested runs far up into millions. Much of the world's product is made in Holland from oils transported from this country, but the Chicago and other American factories supply not only all the American trade but have a surplus to ship in all directions.

The manufacturer of butterine merely uses a new way of producing a well-known food product. He does by machinery what the cow does by the laws of nature. By analysis certain ingredients are found in butter, and oleomargarine is made by obtaining them from some other source and combining them in the correct proportions. One of the principal of these is olein, an exceedingly rich oil secreted by the udder of the cow. The discoverer of the new process argued that if olein was found in the milk it would probably occur elsewhere in the animal, and by analysis he learned that caul-fat, which forms a cushion and blanket for the intestines, was rich in the substance. It was a comparatively simple process to extract the olein and make it the basis of butterine.

In one of the great Chicago factories a whole building is devoted to obtaining olein or oleomargarine oil, as it is more familiarly called, from the caul-fat. As soon as the fat comes into the manufactory from the slaughter house it is dumped into a vat of water, where all the blood and dirt are thoroughly washed away from it. It is then carried to an upper floor, where it is poured into a row of iron kettles, provided with steam jackets for heating purposes. Here the temperature is carefully raised to 155 degrees—at a higher temperature than that the fat will burn—and the oil slowly tries out, assisted by revolving toothed shafts not unlike the agitators of an ice-cream freezer.

When the skilled eye of the workman sees that the fat has been sufficiently heated it is drained to the next floor into large, cool kettles or clarifiers, where all the dirt and refuse, if there are any, settle to the bottom. The clear oil is then drawn out into tin-lined trucks by means of a siphon, and trundled away to a big room, where it is allowed to cool and granulate for three days at a temperature of 85 degrees.

At the end of that time it is sent downstairs to the press room. This is a busy place. All the men are clad in neat white jackets and their sleeves are rolled to their shoulders. The truck, with its yellowish white contents, is wheeled to a little table, around which four men are standing. In front of each there is a small rectangular box open at the top and fastened to the table. Over this the workman spreads a piece of stout white duck. Enough of the tallow oil is dipped up to fill the box, and then the next workman takes it in hand, folds the top of the duck over the soft mass and passes the cake up to the man on the presser. This machine consists of sixty pieces of sheet iron loosely fastened at the ends to shafts. Between each pair of these plates eight of the little white duck packages of tallow are placed, and when the whole machine is full, pressure is given by means of a screw at the top. As it increases gradually the oil is squeezed out through the duck and drips downward into a trough. Of the fifty pounds of fat to an animal, twenty-nine pounds are oleomargarine oil. When the pressure is removed the flattened duck packages come out filled with a pure white cake, an almost tasteless substance known as stearine, which is used as an ingredient in making certain brands of lard. The oil as it runs from the press is ready for use in the making of butterine. Part of it goes directly to the factory near at hand, and part is barreled for shipment to Holland.

The oleomargarine factory is a most interesting place. On entering the building a visitor is struck almost at once by the scrupulous cleanliness of the floors and tables. They are polished and repolished, until they are almost as white as the proverbial New England kitchen floor. All the employees throughout the building are clad in white jackets and aprons, and the girls in the packing rooms wear dainty white caps.

The process of making the oleomargarine begins on the third floor of the building. Here in one corner of the room a stream of oleomargarine oil of a bright amber color is pumped into several large steam-jacketed kettles, where it is kept stirred by means of dashers similar to those in the trying-rooms. The temperature is carefully raised to 185 degrees to melt the oil thoroughly, and then it is conveyed into large tin-lined vats, where it is stored and chilled. It is then passed through a bath of brine, where it is washed and deodorized, and when it comes back it looks a good deal like light brown sugar, and has a distinctly buttery taste. It is packed in tin-lined trays about six feet long by three wide, and placed in a cool storeroom until it is needed for use. Everything about this storeroom must be kept free from dirt, for the reason that the oil, like butter, is so sensitive that it readily takes up foul odors. A single drop of kerosene in the room might taint and ruin a whole supply of oil.

Into the storeroom, "neutral," as it is called, or the purest leaf lard, which has gone through the process of deodorizing in brine, is brought and stored. As these two parts of the oleomargarine, both of which are practically without taste, are needed, they are trundled out on trucks, and two workmen with their sleeves rolled up shovel them in equal parts into the flaring tin funnel of a chute which leads to the creamer; below.

On reaching the next floor the mass fal into a big vat or churn, heated to 180 d grees, and is rapidly stirred by two m with wooden paddles until the lumps disappear. To assist in this operation sn sieves are also used. When the mass been rendered homogeneous a certain q tity of genuine butter and butter sometimes to the amount of 20 per cent of the whole, is put in, together with a little butter-color of the same kind that is used in ordinary creameries, and the stirring goes forward again. The genuine butter used is churned in a revolving churn near at hand, the milk being purchased and collected in exactly the same way as in a creamery. In fact, one end of the oleomargarine churn room is nothing but a small creamery. The cheaper grades of butterine do not contain quite as much butter, and they are usually churned by machinery instead of by hand.

When the oleomargarine comes from the churn it has very much the appearance of butter. It is dumped on a circular table, and a long, conical butter-worker operated by machinery squeezes out the buttermilk and works in the necessary amount of salt. A man in a clean jacket helps along the process with a wooden paddle. When the butterine has been sufficiently worked and loaded into one of the tin-lined trucks it looks like real butter, and no one but an expert can tell it from real butter. The creamery has a capacity of 20,000 pounds in twenty-four hours, and 100 men and 100 women are required to do the work.

After standing one day in a clean, cool storage room, and then being reworked, the oleomargarine is taken downstairs to the packing-rooms. Here white-jacketed men and girls stand at tables with mountainous heaps of the moist yellow butterine in front of them. With a deft movement a man scoops up a handful and plasters it into a mold holding one pound. Then he drops it out before a girl, who wraps it up in a piece of parchment paper, and it is then packed away in boxes. In this department the greatest care is taken to have everything sweet and clean. The floor and all the tables are scrubbed at least once a day.

All the boxes and firkins have to be marked and stamped with great care; for Uncle Sam is very particular about butterine, and when a manufacturer wishes to make it he has to pay a license fee, and there is a further tax on all the product manufactured. Each package must bear the factory number and the name "oleomargarine" in plain type, so that no one will be mistaken and take the product for butter. Besides this, many of the states have separate laws on the subject which more or less restrict the sale. But in spite of all these impediments an enormous quantity of the product is manufactured and sold every year. Many persons prefer it to butter, especially in the large cities.

Chemically butterine is almost identical with butter. Here is the analysis of the two:

	Butterine.	Butter.
Water	12.01	12.13
Palmitin	18.31	16.83
Stearin	38.40	35.39
Olein	24.05	22.93
Casein	.74	.48
Salts	5.22	5.22
Glycerides of the lower fatty acids	1.26	7.01

PEANUTS AND THEIR USES

The American peanut industry flourishes mostly on account of the craving of the small boy. Wholesale commission merchants and grocers ship the raw nuts from the south in great, rough sacks, and they are sold out in small quantities to the street-corner fruit venders. But the charms ıe pudgy bag with its two little ears their own with difficulty against the ge of sticky candy with its conglomeraı of nuts. Besides the sale in these ms confectioners within the last few ars have been making a good many salted ;anuts, and some persons prefer them to lmonds.

But outside of the consumption of peanuts in these forms—and the voracity of the small boy makes the quantity enormous—the peanut has other increasing uses in this country. The manufacturers of health foods and cereals are beginning to use it in various ways. Many a table has peanut sandwiches with salad dressing frequently served, and peanuts are used in omelets and with other fancy cooking. Furthermore, many a person with epicurean tastes who orders a salad at a downtown restaurant, and pours over it what he believes to be a rich oil of the olive, is using only a product of the humble peanut. Indeed, so fine is the peanut oil made in foreign countries, that it is difficult for even the most expert dealers to tell it from the genuine olive oil. Being a great deal cheaper, it is therefore much used as a substitute.

The manufacture of peanut oil in Marseilles, France, and in Germany, has grown to be, within the last ten years, a great industry. The peanuts used come from the east and west coasts of Africa, Mozambique, India and the United States, and a very few from the Argentine Republic. The best grades for the production of oil come from the valleys of Senegal in Africa, yielding about 51 per cent of oil in weight. The American peanut is smaller in size, but much finer in grain and of a far better flavor. The oil, however, is not of as good a quality, and the nuts yield only about 42 per cent of oil.

The process of expressing the oil is similar in a good many respects to that used in the cotton-oil mills of the south. Most of the nuts are imported shelled, owing to the greater ease with which they are shipped. As soon as they reach the factory they are placed in a machine which resembles the American fanning mill for wheat, and the dust and pieces of shell are blown out. They are then ejected into a cylinder, through which they are propelled by an Archimedean screw to a pair of heavy iron rollers, through which they pass and are crushed. These rollers are so constructed with springs that if a hard body, like a pebble or a piece of iron, gets between them, they will spread apart enough to let it through.

Passing the first crushing machine the partly broken nuts are carried forward t the second, where the pressure is greate and they are again crushed. From he they are bolted through a sieve, the fin peanut "flour" as it is called, shaki through, and the coarser remaining to ground over again. The flour is conve along by means of another Archime screw to a pair of mill-stones, simil those used in an old-style flour mill. sifts out of the spout it is carried to a vat, where it is slightly heated an pressed into "scourtins" or woven l horse hair. The scourtins are conv the hydraulic machine, where they jected to the tremendous pressure pounds to the square inch, and le hour. At the end of that time a that can be obtained in the fi about 40 per cent, has been extra is the most valuable product of tl readily brings from $7 to $8 per 100 pounds, and is a fine, clear oil of about the color of olive oil.

After the first pressure the meal is removed from the scourtins and raised to a temperature of about 158 degrees, after which it is again pressed and this time yields about 13 per cent of oil. This second pressing is worth only about half as much as the first.

Besides the use of the oil for salads it is extensively devoted to the manufacture of fine soaps, for which France is noted. The greater proportion of it is consumed in this way. The finer parts of the first pressing are also used extensively in the manufacture of oleomargarine and other compounds placed on the market as substitutes for butter.

The shells and husks of the peanuts are sometimes ground up and fed to cattle, but for the most part they are regarded as valueless. But the refuse left in the scourtins after all the oil has been extracted, is becoming yearly more valuable. Indeed, it is now regarded in Germany as the main product of the oil factories. As a food for cattle and sheep it has a value of $30 to $40 a ton. It is also fed to horses in cold weather, but in summer it has been found to be heating. Within the last few years its usefulness has been much extended by the preparation in Germany of peanut flour for the use of the army and for general consumption. It is exceedingly rich in nitrogenous substances, and is therefore an excellent substitute for meat.

It is made in several forms: First, peanut-grits, the coarse meal dried, purified, bolted and packed in papier-mache boxes containing one German pound, and sold at retail for 12 cents each. In this form it is used for soups and cakes. Peanut-flour, the second product, is much finer than the grits and it is a most palatable dish. When cooked it tastes a good deal like oatmeal. Peanut biscuits or crackers are the third manufactured product, and they are said to be not only toothsome but nourishing. A biscuit is also made with the addition of a little chocolate for the use of persons suffering from diabetes or from excessive stoutness. Its richness in protein, and its low proportion of carbohydrates, like starch and sugar, give it its medical value.

Extensive experiments have been made in Germany in feeding the inmates of the hospitals, and, although many of them were afflicted with dyspepsia and other alimentary diseases, it was found that the peanut-flour food was not only enjoyed by the patients but well assimilated. The German government has also tried it as rations for soldiers, and it will probably be more extensively used in the near future. Peanut-oilcake food may, before many years, be as common on the restaurant bills of fare in American cities as buckwheat cakes.

IN A MACARONI FACTORY

Each year the Americans grow fonder of macaroni. They are pressing the Italians hard, as lovers of the flour-paste tubular dainty, and every restaurant now is prepared to serve up macaroni, spaghetti and vermicelli in a dozen different ways. Italians brought to this country with their appetite for macaroni the tools for making it. All they needed besides the tools were flour and water, and little macaroni factories sprung up in New York and Chicago. In them the macaroni was made as it has been made in Italy for a century or nore. The kneading, mixing and other parts of the simple process were all done by hand, until the Americans happened to think that the macaroni business was bound to grow, and then machinery began turning out the tubes.

In Chicago, not far apart, are two macaroni factories. In one, Italians with bared arms work over the flour and carry it through all the processes by hand. In the other, the paste is kneaded under iron knuckles, rolled beneath granite boulders, and squeezed into long tubes by steam power. The machine can turn out more macaroni in a day than the Italian can, but the Italian's factory is more interesting to the man who wants to know how macaroni is made.

Only the hardest and flintiest wheat is used to make macaroni. Hard Minnesota and Dakota wheat is the best. The Italian takes his wheat, washes it and dries it carefully. After it is dry, the wheat is ground or pounded into coarse, cracked wheat, and it is then put into a revolving screen which is turned by a crank. This screen makes the first separation, dividing the starch, bran and hard parts of the wheat. Then the broken wheat is sifted through a number of hand sieves, beginning with a coarse mesh and ending with a fine mesh. The knack of swinging the sieve, tossing the grain from one side to the other, and bringing all the bran to the middle or on top, is acquired only after long practice, but when the broken wheat has gone from one sieve to the other it is clean, bright, free from bran, and almost polished. In this stage it is called semolina.

The coarse flour is next mixed with warm water, and kneaded by means of a lever *which* has on it a three-faced block of wood, with the sharp edge of the prism down. Two men work this lever and block of wood into the dough, sometimes with a chopping motion and then sidewise. A spring lifts up the levers so that the men have nothing to do but bear their weight on it to force it down.

After it has been kneaded and worked for an hour or so, the dough is ready to be made into tubes. This is done by pressure. The dough is placed in a cylinder, which stands upright, with the top open, but the bottom is closed with a perforated plate, the holes being the exact size of the macaroni sticks. A quantity of dough is put into the cylinder, and then a plunger is put on top of the dough. Half a dozen men take hold of the lever and bring it down, and fifty soft, pliable macaroni tubes shoot through the perforated plate.

The sticks are made hollow by means of little round plugs, held in the center of each hole by pins. Of course, these pins split the macaroni into two half-tubes as it passes through the perforated bottom of the cylinder, but the dough is sticky and joins together again, below the pins, so that the tubes show no signs of having been separated. While the macaroni sticks are coming through the perforated plates, they are fanned briskly to keep them from sticking together, and they are cut off abou every ten feet, and hung over woode frames, where they are kept until dry, har and brittle.

Italians are the workmen in the Ame can factories too. They first put ab 100 pounds of the semolina into a m ing machine. This is of iron, ab three feet deep and two feet in diame Down the center is an upright shaft, w has round bars of steel sticking fro like quills on a porcupine. The broken wheat, mixed with hot water, is worked into a dough by the steel bars moving around in the mixture, and when the dough is stiff enough it is taken out and put into a rolling machine. The rolling pin of this machine is a granite wheel which looks like an enormous grindstone and weighs about three tons. This granite roller moves around in a circle over the dough, which is placed in a circular strip on the wooden bed around the edge. For three-quarters of an hour the granite rolling pin squeezes the macaroni dough until it has a satiny feeling.

Next comes the kneading machine. In this machine conical shaped iron-cogged wheels dig their hard knuckles into the dough and thoroughly work cut any hard spots that the granite roller has missed. After half an hour in the kneading machine the dough is ready for the press. The cylinder of the press is somewhat like the hand press of the Italian, only it is larger and stronger, for a pressure of 1,000 pounds is brought to bear on the dough, squeezing about 100 pounds of macaroni in three-quarters of an hour. The macaroni tubes are cut off every ten feet, and then are taken to a table where they are cut into proper lengths for packing. Then the macaroni is taken to the drying room, and kept there on racks for eight days, when it is packed in boxes for shipment.

VINEGAR AND ITS MANUFACTURE

No farm cellar in the apple region is quite complete without its vinegar barrel. Each fall as soon as the sweet cider comes in from the presses, a part of it is funneled into a dusty barrel that occupies a place in the corner of the room. It is given every opportunity to turn "hard" and then sour, as sour as the sourest vinegar. Sometimes the housewife hurries the operation by adding a little "mother" — the thick, velvety growth, a product of fermentation, which sometimes rises in her cruets and jugs. By the next spring or summer, if conditions have been favorable, the cider has become vinegar and is ready for use with the early lettuce.

But that is a slow process and only small quantities are made at a time. If the city epicurean depended on such a source of supply, he would have to take his salads without the acid element. For this reason great manufactories have sprung up, and many of them weekly make more vinegar than all the farmers of Michigan or any of the other apple states make in a whole year.

The visitor is warned of his approach to a vinegar factory while yet a long way off. There is a pungent odor not unlike that of long confined smoke, and the atmosphere for blocks in every direction fairly reeks with it. On approaching nearer it grows more and more acid, until inside of the building one has the rather novel sensation of tasting air. It is almost equal to eating pickles.

Vinegar is of two or three different kinds. The most expensive is made from red wine, and is of a deep purple color. It is very strong in acid, so strong, indeed, that it fairly bites the tongue. It costs about 40 cents a gallon. Then there is the cider vinegar of farm fame, and it is most popular of any for general household use. It retails from 12 to 16 cents a gallon, and it may be said in passing that some disreputable concerns make a variety of "cider" vinegar that is wholly guiltless of apples. Great quantities of white-wine vinegar are

› made, usually from corn and rye. It perfectly colorless, very sharp to the ›te, and is usually used for making pickles ıd condiments of various kinds.

The process of manufacturing this white- vine vinegar is most interesting. In the first place, the manager starts out just as if he were going to make genuine corn whisky, but when he gets part way through with the work he suddenly switches off and the product is vinegar. The corn and rye come to the side of the factory in cars, and are elevated to the top floor, where they go into big bins. In the morning when the superintendent gives the word, a workman pulls the slide from a spout that leads down through four stories and into the top of the cooler, a huge iron boiler holding 100 bushels. The corn comes rattling down, and it is soon boiling away under a steam pressure of sixty pounds. At the end of two hours it has been reduced to mash—a well-known whisky term — and is quite toothsome enough to tempt any cow home from a June pasture.

It is now blown through a pipe leading upstairs to the great mash-tubs, holding 8,000 gallons each. Here fifty bushels of malt, fresh from the maltsters and ground to a pulp in a little mill on the next floor, are dumped in, and two awkward paddles begin to revolve, churning the mass until it looks like the surface of a geyser.

The cooking of the corn separates the starch, and the addition of the malt, together with a temperature of 148 degrees, turns the starch into sugar. At this period of the process the mash has a really sugary smell, like molasses candy on the back of the kitchen stove. After being beaten and churned for three or four hours, cold water *is turn*ed into a coil of pipes in the bottom of the huge tub to cool the mash. In the meantime some workmen have been preparing the yeast in a little room at one side. Malt and rye are boiled together in a copper-lined kettle holding 200 gallons, and, a little of the yeast ferment being added, the plant begins to grow. When the process has gone far enough, just the right proportion of the yeast is taken out and "planted" in the mash-tub, where without more ado it begins to make itself felt.

Now the mash is allowed to slide down through a pipe to the fermenting tanks, where it sizzles and bubbles away for seventy-two hours, hard at work fermenting. The alcoholic spirits are being slowly extracted by the "working" of the sugar. Thus far the process has been almost identical with whisky-making.

A busy, chugging link-pump now sends the mash upstairs to the stills—real whisky stills, except in the use of "worms" or coils of pipe for collecting and condensing the alcoholic spirits. A "worm" would be used in vinegar manufacture, but Uncle Sam is afraid that some day a very well-meaning charge of corn might by some mistake tur to whisky instead of vinegar. Uncle Sa always looks after such things in a prom and business-like way.

The alcohol is forced out of the m and into the still by means of steam, wl rapidly vaporizes it. The pipe in the is surrounded by cold water, which qui condenses the alcohol and collects it l in a receptacle. All the rest of the —"slops," as it is known to the v man and the whisky man—is carried one side where it is stored up ready to the stock raiser for cattle feed. tains all the corn except the alcohol and it therefore makes very rich f

The spirits are now pumped to the generators, the only distinctive vinegar-making devices in the whole process. These consist of tall, cylindrical tanks of white wood, bound with iron hoops. They extend from floor to ceiling, with an appliance on top for allowing the alcohol to trickle in and a cock at the bottom through which the vinegar may be drawn off. Several floors are covered with these generators as thick as they can stand, and the visitor who goes among them is compelled to sneeze in deference to the pronounced acidity of the atmosphere.

The tanks inside are filled from top to bottom with beech shavings—nothing more. When the alcohol drips in at the top, it spreads over the shavings where the air has ready access to it. The oxygen pounces upon it and changes it without more ado into acetic acid or vinegar, in which condition it runs out at the cock and into a trough that carries it down to the next floor into a huge storage tank. The shavings in the generators are merely for the purpose of providing a great amount of surface over which the spirits must flow.

After having seasoned for a time in the tanks, the vinegar is pumped out into barrels, labeled, and sent all over the country to the pickle manufacturers. Every bushel of corn makes about four gallons of white-wine vinegar, which sells at all the way from 7 to 10 cents a gallon.

The cider used for vinegar comes almost entirely from Michigan, Ohio and New York, enough being secured every fall to last a whole year. The barrels are corded up in endless rows—a whole great room filled full, with only little alleyways piercing it—and allowed to stand until the cider is quite hard enough to make an old cider-drinker dizzy-headed. When at last it has sufficiently fermented, it is run over the shavings in the generator and becomes a light-brown cider vinegar. It is now run into old whisky barrels, and allowed to stand as long as possible. The whisky barrels assist greatly in the ripening process, which so much improves vinegar. Only a few firms in the country have this method of making their product more palatable.

Red-wine vinegar is made just like cider vinegar, a shade greater care being taken, perhaps, to keep it clean and pure. The wine used comes largely from California and Ohio, which of late years have been making a good deal of it. The factory can easily turn out eighty barrels a day, and when one considers that a teaspoonful at a meal is a very large average for the ordinary adult, it will be seen how far such a quantity will go. The prices are now so cheap that the farmer can hardly afford to make vinegar, even for home consumption. He can sell the cider to better advantage.

HOW FRUIT FLAVORING EXTRACTS ARE MADE

Since soda water became the regular dissipation of the summer girl, the extract-making industry has assumed enormous proportions. Where ounces of lemon and vanilla were used by housewives and chefs a dozen years ago, gallons are now consumed in the corner drug store. To accommodate this great growth in business, manufacturing plants have sprung up through the country, and they are yearly adding to their equipment in order to supply the ever-increasing demand.

Vanilla comes almost entirely from Mexico, in the form of long, brown, shiny beans, which are tied up in half-pound bundles and kept in hermetically sealed receptacles, so that the rich odor may not be dissipated in the air. The bean grows on a peculiar vine which is said to derive quite as much nourishment from the air as it does from the soil. It is planted in cuttings by the Mexicans, and as it grows it is trained on lattices or palm trees. In the third year it begins to bear, and for thirty summers the crops continue good. In a single month the vanilla bean will grow to its full size, but requires fully six months longer for it to ripen.

After the beans are picked—and their value depends largely upon having them neither overripe nor underripe—the peculiar rich aroma is developed by a complicated process of fermentation. They are first stored under cover until they begin to shrivel, and then they are sweated by heating and inclosing them in air-tight boxes over night. In the course of two or three days the beans have obtained a rich brown color, and present a moist appearance. After being exposed for several months in the sun to dry, they are packed in little bundles and shipped to the United States, which is the greatest extract-making country in the world. Thousands of Mexicans make their entire living by raising and curing vanilla beans. The cost ranges from $6 to $12 a pound, according to the length and quality of the beans, the prices being now pretty high owing to the large demand and the insufficient supply. For this reason vanilla extract is frequently adulterated with tonka or snuff beans, which cost only $2 a pound. They impart a very pungent odor, and a somewhat sharp and bitter taste to the extract.

The unpacking room of the extract factory is as fragrant as a little corner of Ceylon. When the workmen open the tin cans, each of which contains about thirty pounds of beans, the rich aroma rushes out, filling the room. The beans are taken from the bundles and placed in chopping machines that resemble a sausage-cutter, from which they come out as fine as mince-meat. A quantity of the best lump sugar is now mixed with the mass, according to a secret formula, and the whole fragrant "charge" is thrown into a big jacketed kettle. Here the temperature is gradually raised by means of steam, and retained at about the boiling point for forty-eight hours. The sugar absorbs the aroma to a large degree, and when the "charge' is taken out it strongly resembles the grounds of coffee after the liquid has been poured off.

A certain amount is now poured into a twenty-gallon keg, five gallons of deodorized spirits are added, and the keg is placed in a great storeroom where hundreds of others just like it are arranged in long rows. Each keg is labelled with the date of entrance, and at the end of a full year, during which time the alcohol has dissolved all of the vanilla from the sugar and from the pieces of bean, it is ready for the next process. The kegs fill the whole of one great storeroom, and they are valued at more than $150,000.

The kegs are emptied into a large receptacle, and the liquor of vanilla, as it is called, is forced under great pressure through an ordinary filter press, where the impurities, including the bits of vanilla bean from which the essence has been extracted, are removed.

The stream which flows from the press is of a deep brown color, and the odor suggests cakes, ice cream and a great many other good things. It is the pure vanilla extract. After being allowed to stand for a day or two in a small tin tank, the vanilla is drawn off into small receptacles provided with a faucet at the bottom. In this way it goes to a long table, around which a number of neat-appearing, nimble-fingered girls are sitting. One of them fills bottles of sizes varying from one-sixteenth of a pint to a quart, another plugs in the corks, another pastes on the labels, another slips the bottles into small pasteboard boxes and then a man comes and carries the bottles away to be packed in sawdust and sent out to the market.

Vanilla is a rather expensive food commodity, and unless the supply of beans from Mexico can be largely increased during the next few years, it is destined to go still higher. Vanilla has been growing popular within the last few years. Originally there was at least three times as much lemon sold as vanilla, but now the comparative amounts have almost changed places.

The process of making lemon extract is not so difficult as that of vanilla. All of the best essence or oil used by manufacturers comes from Sicily, where the best lemons in the world are raised. The crop is harvested in November or December, the best and largest fruits being picked and packed for shipment to the big cities of Europe. Just before the small and imperfect fruits are entirely ripe, they are picked and divided into sections. After lying in the sun for a day, the lemons are taken, one by one, by Sicilian girls, who scrape off the pulp and squeeze the lemon oil from the rind out into a sponge. When the sponge is completely saturated it is pressed and the oil runs into a specially made copper vessel, which can be hermetically sealed as soon as it is full. A good workman will squeeze a pound of oil or essence every day, the market price of the oil being $2. It takes from 400 to 500 fruits to make a pound of oil.

In this form it comes to the Chicago factory. To get it out of its sealed case the workman chops holes in the copper with an ax, and the oil to the amount of twenty-five pounds runs out. The first process in preparing extract of lemon is the removing of the balsamic oils. Many persons will remember having eaten cake or ice cream which had a distinct taste of turpentine. This was probably owing to the fact that the lemon extract was a poor brand from which the balsamic oils had not been removed. The process is entirely secret, each manufacturer having his own methods of doing the work.

When the oil comes out it is yellow and almost clear, with the delightfully pungent odor of lemon-rind. It is now "cut" with deodorized spirits and then sent into the filter room. This is a great apartment containing tables loaded full of big glass bottles. In the top of each there is a funnel fitted with ordinary druggist's filter paper. Everything is kept scrupulously clean, so that the filtering may go forward without allowing the liquor to collect any dust. There are hundreds and hundreds of these bottles and funnels, and it keeps several girls busy all the time, pouring the liquor into the filters. The room smells like a doubly concentrated Sunday school picnic, where a whole bevy of girls are making lemonade. When the liquor is strained through into the bottles it is clear and yellow, ready for bottling. One pound of oil makes, with the spirits added, one gallon of extract.

When the cook uses vanilla or lemon the process of seasoning is simple. As soon as the cake or custard into which the extract has been put is heated, the spirits holding the real essence in solution are volatilized and driven off, and the essence remains to give flavor and aroma to the cookery.

Orange extract is made exactly like lemon, the oils of the two fruits being hardly distinguishable when they arrive at the factory. The same factory makes extracts of cinnamon, chocolate, almond, nutmeg, cloves, celery, ginger, onion, allspice, and many more, the process in several cases being exceedingly complex and difficult and usually hedged in with secrecy.

Extracts from the fruit of the strawberry, the pineapple, the raspberry, the banana, the pear and the apricot cannot be made, although many experimenters have worked on the problem. These fruits contain so much water that it is impossible to get them condensed enough to secure the true essence. Artificial extracts with the flavors of these fruits may, however, be made. The process is entirely chemical, and the flavors produced are really stronger than the fruits themselves. Many of these extracts are used in cooking and in soda water fountains, but they are all more or less injurious to the health. The proprietors of many of the best soda fountains refuse to use them, preferring to keep a supply of crushed fruits always on hand. Peach extract is made from peach pits.

EXTRACT OF BEEF AND ITS PREPARATION

After many centuries of absolute sway over the destinies of the kitchen soup-kettle, the place and power of the soup-bone is being rapidly usurped by extract of beef. It is so easy and convenient for the housewife, especially if she happens to be a member of the Ibsen society or the Browning club, to take a teaspoonful of black paste out of a little earthenware jar, stir it up in a sauce pan, sift a pinch of pepper and salt and possibly some vegetables, and announce that soup is ready.

Of course this short cut to culinary success will be decried by the New England housewife, who sees the art of her ancestors being thus reduced to a science which any one may master. Her way was to buy the soup-bone herself, being very particular to see that it was a white, juicy joint, with as little meat clinging to it as possible. Then it was ensconced in a kettle and allowed to simmer away all the forenoon, filling the house with the suggestions of a far-away dinner. It was peppered and salted and sipped from time to time to see if it was just right, and when the soup was done it was, of course, delicious.

But the extract of beef method is much more compatible with this latter day hurry and worry, and there are those, even among the housewives whose grandmothers were veritable geniuses at cookery, who have wandered so far from grace as to insist that soup made by the new method is better in flavor and richer than the old style soup.

Extract of beef was invented in South America a good many years ago. Down in Uruguay, Paraguay and the Argentine Republic, vast herds of half-wild cattle roamed the pampas, and the drovers who owned them, by right of being expert with the lasso, found that it hardly paid to slaughter them owing to the absence of a market for the beef. Some of the qu were "jerked," or dried in the sun, and the hides had a value of their own, but the rest of the carcass was ordinarily left to decay in the hot southern sun. At last some man, whose name certainly ought to decorate the pages of history, discovered a way of boiling down the beef, very much as the old-fashioned nurse made beef tea, until the nutritive portions had all been extracted.

After certain filtering processes it was bottled up and sent over to Europe, where it was sold as a tidbit to tickle the palates of the aristocracy. After a time, like everything that economizes labor, it was successful, and every-day people who ran to their luncheons with their heads seething full of figures began to eat it. And once established as a food commodity, the beef-packers of other countries began to devise means of improving it. Chicago took the lead in the work, and to-day the best extract in the world is made in the stockyards packing house of that city.

While the principle of the processes connected with its manufacture is simple enough, the actual mechanical operations are full of complexities, great care and skill being necessary to secure a product which will be acceptable to persons who know what good soup is.

In the first place, the beef is cut from the cattle in the slaughter house. It is mostly fine, lean meat from the forequarters, no shanks or gluey parts of the animal being used. After being thoroughly washed it is loaded into trucks holding about 2,000 pounds, and trundled away to the cooking department, a long room almost filled with two rows of round copper boilers or "kettles," as the men call them. These consist of an upper and lower hemisphere, so built that they can be fastened together hermetically. The lower hemisphere is built double like a custard-cooker, the intervening space being filled with hot water. From the upper hemisphere, which is punctured with a huge, cyclopean eye-glass, there extends a pipe, which is connected at the further end with a vacuum pump.

The charge of 2,000 pounds of meat is placed in the kettle with a little water, the air is pumped out, and the hot water is turned into the jacket. After six or eight hours of cooking the meat is thoroughly disintegrated, and the liquor which surrounds it is thick and pasty. The workmen know when the cooking is complete by examining the mass inside through the glass window. The whole secret of this process is to cook the beef at a low temperature to avoid scorching, and this is done by boiling in a vacuum. In South America no such care is given to the process, and the extract is often very black and bitter.

The liquor is now drained off and clarified by a secret process, after which it is pumped through two or three filter presses, one after another. The filter presses are constructed of solid-iron, corrugated, double-concave disks punctured in the middle and separated with layers of ducking which catch any impurities and retain all the fibers still left in the mass of extract.

From here it pours into a vacuum pan 7 feet high, 12 feet long and 6 feet broad. The entire bottom part of this is filled with steam coils and from the top a pipe runs to the exhaust pump. Enough extract liquor is allowed to flow into the pan to cover the pipes, and here the free water in it is quickly evaporated, the heat and the vacuum both assisting the process. From the first vacuum pan the extract passes to the second, and when it at last runs out it has been condensed to a thick brown paste, containing only about 20 per cent of moisture. In this condition it goes to a mill of the kind used in grinding paint, where it is rendered thoroughly homogeneous.

The packing room is a marvel of neatness. Around a long, narrow table a score or more of girls are arranged, each in a tidy dress, and a natty white cap and apron. The first two or three in the row fill the little white crockery jars one by one from a spout which brings the extract down from the room above. Another girl deftly plugs a cork into the jar, and then in quick succession it is capped, labeled and wrapped ready to go to the boxing room.

Each pound of the extract contains all the nutritive matter in forty-five pounds of meat, and it will make several gallons of soup. Its use is largely confined to the great cities, although it is rapidly gaining a foothold in the smaller towns. In many hospitals it has totally usurped the place of beef tea as a food for convalescents. Many exploring and camping parties have also used it with success, there being no more condensed form of food manufactured. The product of one factory alone amounts in value to more than $1,000,000 every ye: , and it is growing rapidly. As yet the consumption of the Chicago output is confined largely to the United States and Canada.

PEPSIN AND ITS PRODUCTION

Everyone is familiar with the methods of repairing humanity with artificial legs, glass eyes, false teeth and wigs, but it may not be generally known that a factory at the stock yards in Chicago is busy all the year round in making artificial digestions.

For it is the purpose of pepsin to relieve the man whose stomach has rebelled at harmful methods of eating. After each meal he simply takes a little tablet of the digestion, which he carries in a convenient vest pocket, swallows it, and forthwith forgets—in theory at least—his troubles. Anyone will admit that this is a charming arrangement.

In health, manufactured pepsin is not necessary, because the stomach furnishes its own supply. There are millions of little cells that have no other duty than to furnish the ferment, and when the food comes down they eject the supply which they have been saving up, and by its peculiar properties the marvelous process of digestion goes forward. But if a man overworks his stomach by eating too much or too often, or by going to work too soon after eating, the cells grow tired, and finally fall sick, and cannot perform the task set for them. To remedy this difficulty, some inventive genius conceived the idea, about ten years ago, of taking the pepsin from the stomachs of hogs and concentrating it into a convenient form of use. Since that time the process, which was then confined to the chemical laboratory and was conducted on an exceedingly narrow basis, has assumed the proportions of an industry, and thousands of persons are using the product. There are even varieties of chewing gum which are said to contain pepsin in small quantities.

No one knows just what pepsin is. It has never been isolated from the cells of the stomach, and no chemist has ever been able to analyze it. It is to the stomach what magnetism is to the magnet. The United

States pharmacopeia defines it as follows:

"Pepsinum (Pepsin): A proteolytic ferment, or enzyme, obtained from the glandular layer of fresh stomachs from healthy pigs, and capable of digesting not less than 3,000 times its own weight of freshly coagulated and disintegrated egg albumen. A fine, white, or yellowish-white, amorphous powder, or thin pale yellow or yellowish, transparent or translucent grains or scales, free from any offensive odor, and having a mildly acidulous or slightly saline taste, usually followed by a suggestion of bitterness. It slowly attracts moisture when exposed to the air."

The whole process of making pepsin, many steps of which are secret, consists in the isolation of the ferment to as great a degree as possible, there being no way of getting it entirely separate from the cell walls of the stomach.

The laboratory in which it is made is located close to where 1,500,000 hogs are killed annually, and within an hour from the time the animal breathes its last, the part of its stomach (about the size of a man's hand) in which the pepsin can be found, is in the hands of skilful workmen. The pieces are placed at once in rows of crocks containing dilute hydrochloric acid, .002 per cent solution, where they are left all day long. They are then taken out, and the men put them through a secret chemical process to remove the peptone, or the product of the digestive action of the pepsin on the membranous parts of the stomach, with which it comes. It then goes to a vacuum pan, where, by a steady low heat, the moisture is partially removed, after which it is spread out on glass plates, where it dries down to thin, fine yellow scales, having a peculiar brilliant luster. Girls pack the product in bottles, and it is ready for shipment.

The market price is about 75 cents an ounce, and it takes ordinarily about 100 hogs' stomachs to make a pound of pepsin. Numerous tonics composed of wine and pepsin are also made at the factory.

From the stomachs of calves comes the extract of rennet which is also made at the laboratory and largely used in cheese-making. The process of manufacture is simple. The stomachs are chopped up in a sausage machine into fine bits, and macerated in a solution of salt and water. The material is then ready for packing and shipment. Because cheese contains so much of the digestive ferment—pepsin—it is said to "digest everything but itself." Perhaps this is the reason cheese goes with pie as the end of a meal.

STARCH AND HOW IT IS MADE

Starch has a greater diversity of uses, perhaps, than any other vegetable commodity. Here is a family at dinner with a guest or two who have come to spend the evening. Those tea biscuits which the servant has just brought in are light and flaky because the cook used baking powder in making them, and baking powder is more than one-third starch. The shirt bosoms of the men about the table glisten with a polish imparted by starch, and those delicate desserts are nothing but starch and water and flavoring. The heavy Brussels carpet on which the feet of the diners rest was fairly saturated with starch during the process of manufacture, and that is why it is now so firm and stiff. One of the girls wears a cotton waist. In making the cloth the cotton fibers were "sized" again and again in starch, and the sewing thread used was treated in a similar manner. The dab of powder on the nose of the hostess is nothing but starch, and if she ever uses rouge or complexion preparations—of course she doesn't—they, too, are largely starch. Many of these candies, and they are the purest made, contain more or less starch—starch, possibly, that has been first made into artificial gum arabic.

The dinner over, the company moves to the library—a veritable starch realm. All the paper has been sized in starch, the pictures on the wall have been pasted with it, and the book-covers remain in place largely because of the starch used. Possibly, too, the wall paper is fastened on with starch. A young doctor in the party could tell wonderful stories about the part starch plays in materia medica, and how important it is in the preparation of splints and surgical bandages. And there are a great many other less important uses.

The quantities used are something enormous. The annual production in this country is 500,000,000 pounds of corn starch, 2,000,000 pounds of wheat starch and 30,000,000 pounds of potato starch. Of these the most expensive is wheat starch, which is used largely in very fine laundry work. The largest consumers of starch are the makers of cotton and linen goods, and of carpets. Besides these familiar kinds of starch there are tapioca, from manioc-root; arrow-root, from the macanta, and sago, the pith of a species of palm. A kind of starch is also made from the horsechestnut, but the quantities manufactured are small.

Although starch-making is a simple process it was not understood until within the last century. When the corn first comes into the factory, it is taken to a big room filled with vats in which it is placed after all the readily removable dust has been blown away. Warm water is poured over the mass, and changed from time to time for three days. The corn is then soft and pulpy.

It next goes to the grinding mill, composed of buhr-stones, like those used in old-fashioned flour-mills. Here it is pulverized and washed at the same time, by a stream of water which is kept passing always over the stones. The water carries off the pulverized mass to long screens made of bolting cloth, where it spreads out and is further washed by means of pipe sprays above. All the starch that will go through the sieve cloth is caught below and the husks and germs of the corn remain above. This refuse matter makes very excellent feed for cattle, it being rich in oil and nitrogenous matter.

The "starch milk" is now run out on numerous low tables set at an incline. Being insoluble in cold water it quickly precipitates, the water running off. It is now dug up and washed repeatedly in agitator tanks, to get out the gluten and other impurities. Water is the most important factor in starch-making, for unless starch can be washed scores of times it is valueless.

When it has reached the required degree of purity it is packed in wooden molds which are perforated and lined with fine cloth, thus allowing the water to escape. The blocks come out in masses about six by eight inches in size, and they are taken at once to the dry-room, where they are submitted to a high temperature.

The heat not only dries them out, but draws out other impurities which form in a crust on the outside. This crust varies from one-fourth to one-half an inch in thickness, and is scraped off by boys and girls, the scraping being washed. Then the blocks are wrapped in paper and sent to the low temperature drying-room, where the heat breaks them up into the familiar irregular crystals. The starch is now ready for shipment. Certain laundry starches are treated with an alkali before being placed on the market and cooking starch is passed through a pulverizer. Corn will yield from twenty-four to twenty-eight pounds of starch to the bushel. Wheat starch is made exactly like corn starch.

Of late years potato starch has become very popular. It is easily made, the potatoes being simply ground and submitted to a series of washings. Since the sand lands in northern Wisconsin and Minnesota began to be used extensively for potato growing, numerous starch factories have sprung up and great quantities are produced. Being so near the source of supply the work can be done very cheaply. Ordinary American potatoes yield only about eight pounds of starch to the bushel, while German potatoes yield twelve pounds. The department of agriculture has, however, found a potato that will grow in Utah and will produce as much starch as the German variety.

GLUCOSE AND HOW IT IS MADE

Glucose is connected in the minds of many people with all that is bad. Some think it is made from dead horses; others believe that it comes from glue, and most of them are sure that it destroys the lining of the stomach. The fact is, glucose is a sugar, resembling cane and beet sugar in many of its properties, but it is not quite so sweet. It is perfectly harmless, and can be used to advantage as a substitute for the more expensive sugars in preserving fruits, and also making candies, jellies, syrups and like purposes.

A great deal of it is used in the manufacture of wines and beers, for glucose can be converted into alcohol by fermentation. Glucose can be made from any substance containing starch, and practically all of the glucose turned out of this country is made from corn. In Europe potatoes are used as a source of glucose. A bushel of corn yields about forty pounds of glucose.

Corn can be converted directly into glucose; that is to say, it can be ground without preliminary treatment, and then boiled with water and acid until the starch is entirely converted into glucose. But this process is attended by so many drawbacks that most manufacturers prefer to use the longer but more satisfactory process of separating the starch from the remaining constituents of corn, and then using the starch so obtained for making the glucose.

The first step in this process is the "steeping" of the corn. Large wooden tanks are used for this purpose, and from 2,000 to 3,000 bushels of corn are run into one of these tanks and covered with water. The temperature of the water is kept at nearly 80 degrees Fahrenheit during the whole steeping stage. The fumes of burning sulphur, known to chemists as "sulphur dioxide," are blown into the tank from below, and in this way the water and corn become strongly saturated with sulphurous acid.

The object of the steeping process is to soften the corn so that it can be easily ground, and to dissolve the gummy substance which binds together the starch and the gluten. From one to three days are required to properly steep the corn. Then the "steep" water is run into the sewer, the corn is washed with fresh water, a door in the bottom of the tank is opened, and the corn is taken by a screw conveyor to the mill.

There the corn is ground, either between millstones or rollers. If a grain of corn is examined, it will be found that on the pointed end of the grain is a soft, pliable mass which can be easily removed from the starchy part of the grain with a penknife. This soft part is the "germ," and if this germ is pressed between the fingers it will exude an oily substance, for there is about 50 per cent of oil, known as "corn oil," in the germ.

It is valuable as a salad oil, and is used in the making of toilet soaps and in mixing paints. By an ingenious mechanical process the germs are separated from the starchy matter by some of the more enterprising manufacturers. This is done by crushing the corn, before it is thoroughly ground, by running it between corrugated rolls. The crushed corn is then run into a tub of starchy water, which is stirred mechanically.

The germs are much lighter than the starch, and float on the surface of the water, and are carried off through an exit pipe, whose mouth is just below the surface of the water in the tub. The germs are then washed on a gently moving sieve which retains the germs but permits the starchy water to run through.

The germs are freed from the greater part of the water they contain by rotation in a centrifugal machine. They are then dried in hot air, ground, and shaped into *cakes;* the cakes are put into a powerful hydraulic press, where they are subjected to a heavy pressure, and the oil runs out in a steady stream and is collected in a tank. The cakes that remain are a rich food for cattle, and are known commercially as "oil cake," which is worth from $10 to $20 a ton. Most of it is exported to Europe.

The starchy mass left after the germs have been extracted is now ground until all of it has disappeared. The glucose makers recognize four substances in corn—starch, gluten, oil and bran. The germs contain nearly all of the oil and a large part of the gluten, and they carry with them some of the bran. It is now necessary to separate the remaining bran and gluten from the starch.

The ground material is run into a tank and mixed with water until it has the necessary consistency, and it is then forced in a powerful stream on to a mechanical sieve, known as a shaker in glucose factories. The shaker is a frame about eight feet long and three feet wide, covered with fine bolting cloth. It is inclined at an angle of 30 degrees to the horizontal, and in order that the corn may move along it in a steady stream, flowing into the screen at the upper end and dropping off at the lower end, the screen is kept in constant vibration, a suitable mechanism causing it to move back and forth. Numerous jets of water play about the screen at different points. In this way the fine particles of starch and gluten are washed away from the bran, which drops off from the end of the screen and is carried away. The bran is either sold as wet feed, or is dried for shipment as dry feed.

At this point there is left a yellowish milky mash containing starch and gluten, and the manufacturer takes advantage of this fact to separate them. The milky liquid is allowed to run over slightly inclined tables, about 200 feet long. The heavy starch settles near the head of the tables in great quantities, and in less quantities throughout the length of the tables. A large factory will have perhaps one hundred of these tables. The gluten floats away with the water and runs through a pipe at the end of the tables into large settling tanks.

Here it is allowed to settle for a day or two; the water, which is almost clear, is run into the sewer. The gluten that is left in the tanks still contains a large amount of water; most of this is removed by forcing it into a filter press, which retains the gluten and allows the water to escape. The press consists of a series of grooved iron plates with a central orifice; cloths are placed between the plates in such a manner that the solid gluten cannot pass the cloths, but must remain between them and the plates, while the water escapes through the pores of the cloth and leaves the press by a suitable opening. The liquid enters the press by the central orifice. After the spaces between the plates have become filled with gluten the pressure is removed by means of a screw, and the cakes of gluten are removed after separating the plates.

The gluten is thoroughly dried by means of hot-air or steam driers; it is then placed in bags and is ready for the market. It is a gray or yellowish coarse flour, and sells for $20 a ton. It is valuable as a cattle food.

Having now got rid of all his by-products, the manufacturer can proceed at once to the preparation of glucose. The starch is well mixed with water in a tank, and is then pumped into the converters, where it is mixed with about twenty-five pounds of muriatic or sulphuric acid. The converter is a large copper boiler, into which live steam is introduced by means of a perforated pipe. The starch is heated in the converter for about an hour at a pressure of thirty to forty pounds. The heating is entirely done with steam. The conversion is finished when a simple chemical test shows that no more starch is present.

The action in the converter is nothing but a chemical change from starch into glucose, or grape sugar, as it is sometimes called. A fair sized converter will convert 750 pounds of starch at a time to glucose, the yield of glucose being in the neighborhood of 1,000 pounds. After conversion is complete, the operator opens a valve and allows the glucose to enter the neutralizing tank. The glucose, as it enters the neutralizer, is a yellowish-brown liquid, containing about 30 per cent solid matter.

The acid which was added to the starch is still present in the glucose, and the next operation is the addition of a neutralizing agent. If muriatic acid was used for converting, soda is used for neutralizing, but if sulphuric acid was used, marble dust is used for the latter purpose. The workman must be careful to add the exact amount of soda or marble dust required to effect neutralization, for a perfectly neutral product is desired. After the goods are neutralized, some solid matter separates; it is removed by filtration through filter presses, or sometimes by filtration through long canvas bags.

The weak solution of glucose is known as "bag liquor," or "press liquor," at this stage. It must now be clarified, which is effected by passing it over filters of bone coal. These filters are iron tanks twenty feet high, and filled with animal charcoal or bone coal. Animal charcoal possesses the wonderful property of absorbing matter from sugar solutions, and absorbs only a small amount of sugar.

The bag liquor is allowed to percolate through this filter, and comes off the coal looking perfectly clean. After a certain amount of liquor has passed over the coal it becomes saturated with impurities, which are then removed by washing with acid and burning in a kiln. The liquor from the coal is known as "light liquor;" it contains 65 to 70 per cent of water, and most of this must now be removed by evaporation. If a solution of sugar or of glucose be heated in the air it will soon turn brown, owing to oxidation or burning. So, in evaporating a solution of glucose, resort is had to a vacuum evaporator.

Water will boil at a much lower temperature in a vacuum than in air, and therefore the evaporation of a saccharine liquor can be conducted in a vacuum without danger of charring. Ordinarily a system of three evaporators is used together. This is called a triple-effect system, and by using it all the waste steam is utilized. The evaporation is continued in the triple-effect system until the liquor contains about 60 per cent of sugar. It is now filtered over bone coal to remove any remaining color, and is then boiled in a vacuum pan — a large copper boiler heated by means of a steam coil and connected with a vacuum pump—until it has reached the desired degree of concentration.

The operator takes off a sample through a valve when nearing the end of the boiling, and determines its density or gravity by means of a hydrometer spindle. Glucose comes on the market in different grades, according to the gravity. Mixing glucose has a gravity of 41 degrees Beaume; confectioners' glucose 42, 43, and 44 degrees Beaume as desired. The boiling is stopped whenever the desired gravity is acquired. The finished glucose is run off into tanks and is shipped in barrels when ordered.

Glucose is a thick syrup. It should be perfectly clear and colorless, and if properly made will not leave an after taste in the mouth. By some few changes in the method of converting and boiling, a solid crystalline product can be obtained called "grape sugar." Grape sugar is used for making beer and wines.

There are only about half a dozen glucose factories in operation in this country. The smallest of them grinds 10,000 bushels of corn a day; the largest 30,000. Most of the glucose produced finds its way into candy and syrup.

ROCK CANDY AND HOW IT IS MADE

Rock candy is the purest confection made. It is simply large crystals of sugar beaded on strings, and when it is not colored it has nothing in it but sugar, and the best sugar in the market at that.

Time was when every school-boy in the country knew the taste of rock candy, and carried it around in his pockets, but the caramels, gum-drops, Turkish pastes, nugats, chocolate creams and other forms of the mushy candy, which, the dentists say, is ruining the teeth of the rising generation, have shoved the old-fashioned rock candy to one side, and the crunch of strong white teeth on the hard crystals is seldom heard. Large quantities of it are still made, however, and, in fact, the output increases from year to year, for liquor dealers, druggists and patent medicine manufacturers consume tons of the strung sweet. A well-known dentist is authority for the statement that if molasses candy, rock candy and hard bread were eaten by boys and girls instead of paste candies and soft bread the next generation of dentists would have little to do. It requires strong teeth to break up rock candy in the mouth, for the crystals are glazed, hard and smooth-surfaced.

The manufacturer of rock candy begins with refined granulated sugar of the best quality. Brown or soft white sugar will not do; he must start with crystals. He first empties between four and five barrels of sugar into a copper boiler, which is five feet in diameter and between three and four feet deep. After the sugar has been dumped in, from sixteen to twenty gallons of water are mixed with it, and then the steam is turned into the coil of pipes on the bottom and around the sides of the pan. After half an hour's boiling the sugar has changed into a clear, thick syrup, and it is drawn off through a pipe in the bottom of the pan, through fine sieves, into copper pots beneath.

In these copper pots, each of which is about two feet in diameter at the top and a foot in diameter at the bottom, the syrup crystallizes into rock candy. The copper pots have little holes in the sides, and through these holes cotton cords are run, so that the pot from the bottom up is strung with the strings, which are placed in the pots before the syrup is poured in. They are fastened in the holes with plaster, which not only holds the cords in place, but closes up the holes, so that the hot syrup cannot leak out. Each pot holds about five gallons of syrup and weighs about forty pounds, and after they are filled to the top with the boiling syrup, they are carried to the hot house and left there for a time.

The hot house is usually made entirely of brick, with strong shelves on all sides. Under the shelves the steam pipe which heats the house is coiled, and in this hot house the pots, with their sweet contents, are left for two or three days in a temperature of about 160 degrees. The heat causes the syrup to crystallize, and the crystals arrange themselves on the cotton strings and the side of the pot, forming a cover of crystals for the copper pot. When the three days are up, the pots are taken down from the shelves and the thin crust of crystals is smashed in. Then the clear syrup, which is used in saloons and at soda-water fountains, is drained off. Clear water is dashed into the pot to wash the syrup from the rock candy. Then the pots are turned upside-down over a trough, and left there for a day in a temperature of 70 degrees, while the remainder of the syrup drains off and the rock candy becomes glossy and hard. The plaster of paris is scraped from the sides of the copper crystallizing pots, thus releasing the strings, so that when the pots are thumped down upon a table and rapped with a mallet the rock candy falls upon the board and is broken up and weighed out into five-pound and forty-pound boxes.

Yellow rock candy is often colored with burnt sugar, and this is the only disagreeable feature in the making of rock candy. The sugar is burned in shallow copper pans, which are placed directly over the blaze of a hot fire. About 100 pounds of sugar and four gallons of water are mixed together in the pans. In a short time the syrup begins to burn, and a thick, irritating smudge rises from the sugar and compels the workmen to cover their mouths and noses with cloth or wear respirators, for they are obliged to stand over the pans and stir the contents. In a short time the sugar is burned to a crisp and then it is washed with water, pounded, and run through a sieve. The red rock candy is colored with carmine and is the only rock candy made which has anything in it but sugar.

COMMON FOOD ADULTERATIONS

So much is heard about food adulteration, adulterations of dairy products, adulterated spices, and so forth, that many people believe the whole story is a tissue of falsehoods, got up by those who delight in springing sensations upon the credulous public. As a matter of fact, however, 15 per cent of our food materials is adulterated in one way or another, and the figures to prove this assertion are obtained from the United States department of agriculture and many state boards of health. It is such a simple matter for one who knows anything about food materials to mix with them some comparatively cheaper and worthless material, that it is not surprising that unscrupulous dealers and manufacturers resort to this extensive practice.

Everyone is familiar with the milk dealers' frequent practice of adding water to the lacteal fluid. Milk is slightly heavier than water; that is to say, a pint of milk weighs more than a pint of water, or, as a chemist would say, the specific gravity of is greater than that of water. Large consumers of milk frequently use a simple instrument called a lactometer to determine the specific gravity of milk. If the milk has been watered the lactometer readily shows that it is lighter. But the milkman can easily deceive them on that score. Taking advantage of the fact that cream is lighter than milk, he removes some of the cream and adds water until the lactometer shows the proper gravity for the milk. As cream has a yellowish cast, its removal causes the milk to become bluish in color, so the skillful manipulator adds some coloring material to conceal this defect.

Sometimes they add boracic acid or salicylic acid as a preservative to keep the milk from souring. Chemical tests show that all of these practices are resorted to, and it is found that the amount of adulteration is very great where dealers are not subjected to careful supervision, and where rigorous laws against adulterations are not enforced.

Coffee is one of the most commonly adulterated food materials. Sometimes inferior or damaged coffees are subjected to a course of treatment in order to imitate superior grades. It is not an unusual practice to take one of the green coffees from South America and expose it to a moist, high temperature to produce a brown color and thus sell it for Java. Other means have been resorted to for producing coffee of any desired shade, such as the use of pigments. The following substances have been used in this country for coloring coffee: Chrome yellow, Venetian red, yellow ochre, burnt umber, charcoal and French black.

Another method that has been used for "improving" raw coffees is to wash with water, decolorize by treatment with lime water, wash again, dry rapidly, and then roast until the desired color has been obtained. The weight that is lost in the process is restored by steaming, and then the beans are coated with glycerine, palm oil or vaseline. Coffee can be polished by rotation in cylinders with soapstone, or by covering with starch paste or syrup before roasting.

Ground coffees are easily adulterated. Out of thirty samples tested by the department of agriculture, twenty-six were found to contain adulterations; the most common adulterant was chicory, but wheat, peas, barley and even bread were found in some of the samples. Some of them contained only 25 per cent of coffee. The chicory used for this purpose is the ground root of the chicory plant, known to botanists as the "cychorium intybus."

A simple test for the presence of chicory is to throw some of the suspected coffee into a dish of cold water. Chicory sinks rapidly, coloring the water, and soon becomes soft, whereas coffee floats on top and does not color the water. Artificial coffee beans have been made by some misapplied genius. Flour is mixed with some chicory, and occasionally a little coffee, and is then pressed into the shape of coffee beans and roasted until the desired shade is produced. Artificial coffee beans are very hard; in attempting to break or grind such coffee its spurious nature becomes manifest.

Canned vegetables are not usually adulterated in the general sense of the term, but they often contain substances which are injurious from a hygienic standpoint. Canned foods were first introduced into Europe in the early part of the century. The food was placed in a tin can, water was added, and then a lid with a small aperture in the center was soldered on. The can was placed in boiling water and its contents were allowed to boil briskly for some time, and then the hole was closed with a drop of solder.

At the time the process was introduced it was supposed that its efficacy was due to the expulsion of the air from the can; but modern science shows that it is due to the killing of the germs or spores that cause decay when present and alive. Goods canned in this way become soft and mushy, and lose their attractive appearance because of the prolonged boiling.

So the canners looked about for some means to overcome this difficulty. One of the principal improvements, from the canner's point of view, was the use of copper vessels for boiling peas and beans. Imperfectly cleaned copper vessels soon become coated with copper salts, and these dissolve in water and give a deep green color to the vegetables cooked therein. The observant ones soon found that the same effect could be produced by adding copper or zinc salts. Nearly all French peas and beans contain copper, but American products generally are free from it. The amount of copper contained in a can of the most highly colored peas is not large, and a small amount of copper used occasionally will not seriously injure the health of the consumer.

In order to dispense with the long boiling required for effectively killing the germs and spores, canners use antiseptics. For this purpose they add a minute amount of salicylic acid or boric acid to the contents of the can, and then boil the contents a few minutes before sealing. There is a difference of opinion as to whether the use of preservatives in minute quantities is prejudicial to health.

There are three types of baking powder on the market—tartrate powders, phosphate powders and alum powders. All baking powders contain bicarbonate of soda, or baking soda, as it is called by the housewife. In theory a baking powder must contain bicarbonate of soda mixed with some substance that will set free carbonic-acid gas when dissolved in water, and that powder which contains the greatest amount of gas, other things being equal, is the best powder.

The carbonic-acid gas thus generated permeates the mass of dough with which it is mixed and causes it to rise. If that were the only point involved in passing on the merits of baking powder, the solution of the question would be an easy one. But it so happens that the chemicals used in the manufacture of the powder do not entirely disappear as gas, but the greater portion of them remain in the bread in the form of salts, and it is claimed that some of these salts are injurious to health.

Of the various powders used, the phosphate gives off the greater amount of gas, averaging 14.5 per cent; next comes the tartrates, averaging 11.6 per cent gas, and the alum powders contain about 10 per cent gas. There is a class of mixed alum and phosphate powders which give off about 9 per cent of gas; some of them, however, yield as high as 11 per cent. Nearly all of the phosphate and tartrate powders are of high value, but some few of the alum powders are inferior in leavening power, owing to a deficiency of bicarbonate of soda and an excess of starch.

BAKING POWDER, PURE AND ADULTERATED

Baking powder is probably more extensively advertised than any other food commodity in the market, and yet half a century ago it was practically unknown. When the old-time housewife wished to make a pan of biscuit or cake she took a pinch of cream of tartar and a pinch of baking soda, the size of the pinch in each case being a culinary secret passed down from generation to generation, and mixed them with the flour. Not infrequently a "dash" of sour milk took the place of the cream of tartar, especially if the housewife had gained a reputation for "milk-risin' " biscuits. A "dash" was the same indefinite nature as the "pinch," and only genius at cookery ventured to use it.

If the cakes came out all right it was a lucky bake, but if they were sodden and tough or sour and soapy in taste, it was always the flour that was bad, or the eggs were not fresh, or the oven was not hot enough. When the housewife offered excuses at the table she never thought to blame the "pinches" of cream of tartar and soda, or the "dash" of sour milk. But there was where the trouble probably lay.

Sometimes the proportion of chalk to the cream of tartar was unusually large, and how was a poor cook, even though she possessed every mark of genius, to tell how much she used? Besides this, the baking soda varied in strength and purity in a similar way.

To relieve this distressing state of affairs, and to provide better biscuits and cakes, the baking powder manufactory sprung up into existence. Here the cream of tartar and soda were mixed according to exact chemical formulas, and even the bride of a fortnight may now make cakes without ever having been instructed in the mysteries of the "pinch" and the "dash." Of cours there are a great many adulterated bakin powders—any one who reads the advertis ments of the rival companies will be convinced of it—but there are a few manufacturers who really make the pure compound of cream of tartar and soda, with a little starch added as the "body."

Baking powder rises on exactly the same principle as that on which gunpowder explodes. It is composed of an acid (cream of tartar) and an alkali (soda), combined while bone dry, so that no chemical combination takes place. The moment water is added, however, the two substances unite with effervescence, and throw off carbonic acid gas, which permeates the dough and blows it full of bubbles just like little balloons. In baking, the sides of these little bubbles harden and the cake is said to be light. In the same way the ingredients of gunpowder unite and throw off carbonic acid gas, and it, too, makes things rise, but at a somewhat more rapid rate than in the case of baking powder.

If for any reason dough is not well mixed, or the gas escapes from the baking powder without blowing up the bubbles, then the cake is "heavy"—in company with the spirits of the cook.

The manufacture of baking powder has grown to be a great industry. There is one manufacturer in Chicago who alone turns out 50,000 cans every working day in the week, and he had stored in his factory recently twenty car-loads of one-pound cans. A car-load is 1,500 dozen, or 18,000 cans, and in twenty of them there would be 360,000 cans. Each can is six inches long, and the whole number, if placed end to end, would reach 180,000 feet, or about thirty-four miles. Chicago alone uses between 2,000,000 and 3,000,000 pounds of baking powder yearly. Each pound will make about 700 biscuits, thus placing the biscuit consuming capacity of Chicago at 1,400,000,000. Besides this, Chicago is a great distributing center for baking powder. It supplies immense quantities to the western states and exports a considerable amount to foreign countries.

The acid originally used in baking powder is cream of tartar. This is exported from France, Italy and Spain, in the form of lees of wine and argals, both of which are by-products of the manufacture of wine. As every one knows, wine when first expressed from the grapes is not suitable for use. It must "age." As it stands in the French wine-cellars, a fine substance settles out of it and forms in the bottom of the butt. When the wine is drawn off this may be hardened to a pinkish mass known as lees of wine. It contains about 25 per cent of cream of tartar. If the wine is allowed to stand longer, the argals begin to crystallize out on the sides of the butt, in a thin, hard coating. When crumbled off they are a deep purple in color, and somewhat resemble calcspar. About 80 per cent of them is pure cream of tartar, the other 20 per cent being made of impurities, mainly lime. Formerly the lees were sold for fertilizers and the argals were burned for lamp-black, but since the baking-powder industry began to grow, the demand for both has equaled and even exceeded the supply.

Both products are brought to this country in big wooden casks. After being crushed to a fine powder at the refinery, they are boiled in huge copper tanks for some hours. The solution is then allowed to cool slowly, and the cream of tartar crystallizes on the sides of the tank, the lime and other impurities remaining in the solution or being cast to the bottom in the form of a precipitate. Workmen scrape off the crystals, which have assumed a faded brown color, and they are redissolved and discolored by passing through a filter of animal coal. The crystals resulting from a second cooling of the solution are white and about 99 per cent pure. In this form it is ready for use in the baking-powder manufactory.

The center of everything at the factory is the little chemical laboratory. As soon as the casks containing the crystals of cream of tartar and the barrels of soda and starch reach the factory, a sample of each is analyzed to see if it is exactly what it purports to be. The process begins on the top floor of a building, in a wide, low room, which bears a strong resemblance to a flour mill. The atmosphere is heavy with flying particles of cream of tartar, and the visitor who doesn't understand how to breathe that kind of air passes from one sneezing convulsion into another. But the workmen have grown accustomed to having a perpetual sour taste in their mouths, and they rather like it. The crystals of cream of tartar are fed into a hopper of a grinding machine which much resembles an old-fashioned flour mill, and when it comes out it is a fine, white powder. It is then sifted through a number of bolting screens, after the manner of flour, and from time to time it is tested to see that the grinding has been complete. Now the cream of tartar is barreled and placed inside of a little pen in one corner of the room, the soda and starch occupying other little pens not far away. All these ingredients are pure white in color, finely pulverized, and great care must be taken not to get them mixed up. At one end of the room there are three trap doors in the floor, over the first of which the words "Cream of Tartar" are printed in big brass letters, over the second, "Soda," and over the third, "Starch." The workman takes each ingredient from its pen and dumps a few barrelfuls down into bins below. Everything is kept scrupulously clean.

Underneath the third floor the bins narrow to funnels, the mouths of which are covered with draw slides. Under each spout there is a weighing scale over which runs a truck track which continues all around over two traps in the floor. The trucks are most ingeniously constructed. At one side there is a little wooden box set on a pivot. When the truck is under the cream of tartar spout the box is filled with just the proper amount, according to the scale on which the truck rests, and it is then tipped on the pivot until it empties into the body of the truck. Then the truck is trundled along to the next spout and the proper amount of soda is allowed to run from the bin spout into the box, which is in turn dumped, and the same process is repeated with the starch.

The truck now contains a full "charge," the ingredients being mixed according to a secret formula. Starch is added as a "filler" to separate the particles of the cream of tartar and the soda, thus helping to preserve the powder by preventing a chemical combination until the water is added.

The "charge" being allowed to run through the spout in the bottom of the truck, it passes to the second floor into a long cylinder somewhat like a steam boiler. Then the cylinder begins to whir, thoroughly mixing the ingredients. At the cylinder end there is a box covered with canvas, and strongly resembling a voting booth. When the charge is mixed a truck is run into this booth, and the baking-powder fills it. The trucks hold 400 pounds, and a sample from each is placed in a snuff box and sent to the laboratory for analysis. Great pains are taken to see that everything is exactly right.

Now the powder goes to a row of pretty girls, in triangular paper caps, to be boxed and labeled. Each of the tin boxes is filled by weight with exactly the right amount of powder, and the work is done with great deftness and rapidity. Heaped around them on every side are cords and cords of cans, ready to go to the shipping department.

Alum and alum-ammonia are extensively used as the acid element, in place of cream of tartar, for adulterating baking powder. They are much less expensive, but their use is beginning to come under the ban of the law. Various states of the Union have pure food laws that prohibit the use of either. Germany and other European countries are vigorous in their prohibition of the use of these adulterants.

To detect ammonia in baking powder, mix one heaping teaspoonful with one teaspoonful of water in a tin-cup; boil thoroughly for a few moments, stir to prevent burning, and if ammonia is present you can smell it in the rising steam; or place a can of the suspected powder, top down, on a hot stove for a minute or two, then take off the cover and smell.

Alum powder can be tested by putting two teaspoonfuls of the powder in a glass of cold water. If no effervescence takes place, alum powder is present.

ADULTERATION IN ALCOHOLIC LIQUORS

Distillers are not entirely responsible for all the mysterious compounds which are sold under the name of bourbon and rye whiskies, cognac, brandy, rum, absinthe, etc. The man who tackles "John Barleycorn" would not smack his lips so complacently if he knew half of the acids, alkalies and other chemicals he is sending down his throat. He might object to swallowing acetate of potassium, sulphuric acid, blue vitriol, ammonia, or other similar stuff, alone or mixed, but he revels in blissful ignorance, and drinks compounds which carry those identical ingredients. It is frequently said by those who think they know, that pure whisky, pure brandy and pure rum will hurt no one, but a congressional investigation of the tricks and secrets of compounders disclosed the fact that many of the best-known and high-priced brands of whisky and brandy contained but a small percentage of the genuine stuff.

Alcoholic liquors are made from the materials containing starch and sugar in sufficient quantities, by fermentation. If, after fermentation, the liquor is subjected to distillation, it is called distilled liquor, and to this class belong whisky, brandy, rum, absinthe, etc. Brandy is made from fermented grape juice. The best grades of cognac brandy are made from white French wines; inferior qualities are made from Spanish and Portuguese wines. Whisky is made from the fermented extract of rye, barley, or corn. In Scotland or Ireland malted barley is used, sometimes alone, sometimes mixed with other grains. Bourbon whisky is made from rye and malted corn. Gin is produced by mixing common spirits with juniper berries. Frequently other materials are used for flavoring, such as cardamon seed and oil of fennel. Liqueurs are made from brandy and alcohol by flavoring them with aromatic substances, such as orange peel, absinthe and anise;

Things We All Should Know

the flavored liquid is distilled, and distillation it is colored with caramel sweetened in most cases.

The manufacture of whisky will serve as type for the manufacture of other spirituous liquors. The first step in the process is the saccharifying of the grain that is, changing the starch into sugar. The grain is mixed with malt and ground in a suitable mill, and then run into the mash tub, where it is agitated with water at a temperature of 140 degrees Fahrenheit. The mashing process is continued until the starch is entirely changed into malt sugar or maltose. This requires from one to five hours, according to the amount of grain in the mash. Malt contains a substance called "diastase," which possesses the remarkable property of changing starch into maltose or malt sugar. It is for this reason that malt is added to the grain in the mash tub.

Starch is changed by prolonged boiling into dextrin, which does not ferment readily, while maltose ferments very easily. Great care therefore is taken during the mashing process to reduce the dextrin formation to the minimum. This is done by keeping the temperature near 145 degrees Fahrenheit during the whole process. The liquor obtained in the mash tub is called the "wort." When the wort is as strong as possible it is drained off and the grain is treated with a fresh supply of water, and the wort so obtained is added to the first. The wort on coming from the mash tub must be cooled rapidly, otherwise an acid fermentation will set in which produces [illegible] and the presence of such a substance is undesirable.

The wort is cooled by allowing it to flow through cold pipes, which are kept at a low temperature by some system of artificial refrigeration similar to that used for making ice. About five hours are required to reduce the contents of a mash tub to a temperature of 60 degrees. The wort is now ready for fermentation. Fresh brewer's yeast or softened compressed yeast is added to the liquid, which is stored in wooden tanks in the cellar of the distillery. One gallon of brewer's yeast or one-half pound of compressed yeast is used for every 100 gallons of wort.

In the early stages of the fermentation the yeast cells grow without producing much alcohol. Later the malt sugar ferments and alcohol is formed; the dextrin gradually is changed to maltose, and this is then changed to alcohol by fermentation.

During the fermentation the temperature gradually rises because of the chemical changes taking place. The temperature should be kept near 93 degrees Fahrenheit in order to get the best results. Fermentation is complete when no more alcohol forms, and this takes from five to nine days. The yeast is skimmed off, and the fermented wort at once is subjected to distillation. The object of distillation is to increase the percentage of alcohol in the liquor, and at the same time to remove undesirable substances from it. The undistilled liquid contains alcohol, water, solid matter, fusel oil and other substances.

Alcohol boils at 172 degrees, water at 212 and fusel oil boils, some at 207 and some at higher temperatures. If a mixture of such liquids be boiled and the resulting vapors cooled, the process is called distillation. If the liquid which distills over and is condensed be collected in different portions or fractions, the first fraction will contain a larger percentage of alcohol than th original liquid, for the alcohol distills o at the lower temperature. The remaining fractions will contain more water and fusel oil. The first portion will not contain all of the alcohol, nor will it be entirely free from water and fusel oil, but if it is redistilled the percentage of alcohol will be greatly increased and the amount of water and fusel oil will be correspondingly diminished.

The old stills were based on this principle, and many such stills are used to-day in Scotland and Ireland. These consist of large, flat-bottomed vessels of copper set in brick work and heated underneath by direct firing. The still is connected at the top with a long spiral pipe called a "worm," which passes through a tank of cold water, where the alcohol vapors are cooled and the distillate is collected at the other end of the worm in a suitable tank. This method of distilling is wasteful of fuel, and for that reason a number of devices have been introduced for reducing the cost of the product and improving the quality.

The improved stills are somewhat complicated in construction, and they are continuous in action; that is, the liquor to be rectified is fed in a steady stream without interruption to the process, and the rectified spirits are drawn off continuously. A standard still consists of two columns made of wood, copper lined, called respectively the "analyzer" and the "rectifier." The analyzer is divided into a number of compartments by perforated copper plates, supplied with valves opening upward. Small pipes pass through each plate, projecting about half an inch above each plate and reaching down into small copper pans placed on the plate below. From the analyzer the vapors enter the rectifier, which also is divided into compartments by perforated plates until near the top of the column, which is free from plates, and where the finished spirit is held back and carried away to the condensing worm.

The liquor to be rectified is pumped through a zigzag pipe which circulates through the rectifier. When it reaches the bottom of the rectifier it is entirely changed to vapor. The vapor then goes to the analyzer, which is heated by steam from below. The water condenses and runs off at the bottom of the analyzer; the vapors of the alcohol pass into the rectifier, where they circulate through the compartments, and as they ascend they are almost entirely freed from the water and fusel oil. The vapor then passes through a condensing worm, where it is thoroughly cooled and liquefied, running into storage tanks.

Not all distilled liquors are made this way. Some require to be heated by direct firing in order to develop certain peculiar flavors. Large quantities of spirituous liquors are made, however, from spirits destitute of flavor by blending with them suitable flavoring extracts and substances. The skillful compounder will take some highwines or spirits, mix with them a small amount of genuine whisky, add a few drops of essential oils, put in some sugar color, and bottling the mixture, will paste on the bottle a label bearing the name of some well-known brand of whisky.

A great deal depends upon the flavoring matter, and each compounder has his secret mixture which produces his particular brand of whisky. Prune juice is a favorite flavor with compounders and a mixture of extract of tea and currants is used for rye whisky. In order to give an artificial "bead" to inferior liquors they are treated with a beading oil made from oil of bitter almonds by a simple chemical treatment. Bourbon whisky sometimes is made by adding an oil which consists largely of fusel oil which has been treated with acetate of potassium, sulphuric acid, blue vitriol, ammonium oxalate and black oxide of manganese. "Scotch" whiskies are made by adding to a small quantity of real Scotch whisky, oil of birch and spirits. Cognac is made from spirits by flavoring with cocoanut oil and coloring with burnt sugar, and there are other tricks in the whisky trade too deep and mysterious to be penetrated by one outside of the inner circle.

TOILET PREPARATIONS FROM THE TROPICS

Americans and Europeans draw on the Orient and the tropics for a very wide range of supplies. Not only do tea, coffee and spices, rare woods and silks, and queer art trinkets and treasures come from far away, but some other things less conspicuous but still not to be ignored. We know what value the brown natives of the Pacific and Indian oceans place upon the palm tree in its various forms, how they obtain from it not only shelter and fuel but actually food and drink as well. We ourselves likewise owe our gratitude to the palm tree for many favors. Familiar enough are sago from one variety, cocoanuts from another, and fans from a third. The areca palm or betel-nut palm is another which contributes to our comfort, though we are hardly as well informed about it. This tree is one of the most beautiful of all the palm species, and in the Malay archipelago and the peninsulas of India and Burma, where it flourishes, attains a height of eighty feet.

The nuts themselves grow in crowded bunches or clusters, each nut about the size of a hen's egg. The cover is a hard and glossy rind, sometimes almost like mahogany in its polish and hardness. Next inside

ARECA-NUT, FRUIT OF THE BETEL-PALM.

comes an albuminous mass, and then in the center is a large seed-like kernel which when cracked yields a nut-like substance. From the contents the natives make their favorite chewing compound, which they much prefer to tobacco. Bits of the betel-nut are mixed in the proper proportion with lime, and a morsel of the mixture is wrapped in a small leaf. This entire combination is placed in the mouth and chewed. The results are very repugnant to a traveler who is not used to such things. The saliva produced is of a bright red color like blood, and it is expectorated constantly during the chewing process. The lips of habitual betel-nut chewers crack and bleed, and their teeth become blackened and loosened from the gums, but in spite of that they stick to the offensive habit faithfully.

The American and European use of the betel-nut is fortunately a wiser one. The nuts are shipped to us in great quantities, having been picked by the natives who have whole forests of them growing wild at their disposal. They are bought by druggists and manufacturers of toilet preparations, and are converted into drugs and into tooth powders and pastes. The medical use of them is as a vermifuge. Of course the substance of the nut is modified by mixture with other things when made into tooth powder, so that its cleanses and whitens the teeth instead of blackening them, as it does for the Malays of the Indian ocean.

The cocoanut palm provides us with its delicious nuts, to eat in their natural form or after preparation as puddings and pies. In addition to this use, however, the half-dried nuts are shipped to this country in great quantity as "copra," to be made into cocoanut butter, soaps and cosmetics.

AMERICAN PROGRESS IN TWENTY YEARS

One of the most fascinating official bulletins ever issued by the government made its appearance in the annual report of the bureau of statistics of the Treasury Department in August, 1902. It is entitled "Progress of the United States in its area, population and material industries." The story it tells is perhaps the most marvelous to be found in the history of all the nations. It shows in compact tabular form the development of the United States to a great and wealthy nation, all the material facts being arranged by decades, beginning with 1800 and ending with 1900. Of course any comparison of the end of the century conditions with those found at the beginning of the century would show a development from almost nothing to the great American empire of to-day.

Of far greater importance and interest is the growth of the United States during the last twenty years. Probably no other nation ever made such rapid strides as the United States has made since 1880. The official figures which measure this growth are simply amazing. Remember that the period under consideration is only twenty years, a trifle in the life of a nation. At the beginning of this period the United States was already one of the greatest nations. Its population had swept across the continent. It had recovered from the disaster of the civil war. It had enjoyed years of large crops and uninterrupted prosperity. Yet the development since that time reads almost like a fairy story rather than a tale culled from the sober figures of census and other official statistics.

Since 1880 the population of the United States has increased by 50 per cent.

The aggregate wealth of the country, "the true valuation of real and personal property," has more than doubled—from $42,000,000,000 to $94,000,000,000.

Wealth per capita has increased 50 per cent—from $850 to $1,236.

The public debt, less cash in the treasury, has decreased nearly one-half—from $1,919,000,000 to $1,107,000,000.

The debt per capita has dropped from $38.27 to $14.52.

The annual interest charge has diminished more than one-half—from $80,000,000 a year to $33,500,000, and per capita from $1.59 to 44 cents.

The amount of gold coined has increased more than 50 per cent—from $62,000,000 a year to $99,000,000.

The amount of gold in circulation has nearly trebled—from $225,000,000 to $611,000,000.

The amount of silver in circulation has more than doubled—$69,000,000, as compared with $142,000,000.

The total circulation of money has more than doubled—$973,000,000, compared with $2,055,000,000. Circulation per capita has increased only 50 per cent—$19.41 compared with $26.93.

The number of national banks has nearly doubled—2,056 compared with 3,606.

Deposits in national banks have well-nigh trebled—$1,006,000,000 compared with $2,625,000,000.

Deposits in savings banks have almost exactly trebled—$819,000,000 to $2,450,000,000.

The number of depositors in savings banks has increased from 2,235,000 to 6,108,000.

That the farmers of the country have shared in this wonderful increase of wealth is clearly shown by further comparisons of 1880 with 1900.

The value of farms and farm property has grown from $12,000,000,000 to $20,500,000,000, an increase of 70 per cent.

The value of the yearly products of farms has increased from $2,212,000,000 to $3,764,000,000.

The value of farm animals has increased from $1,882,000,000 to $2,982,000,000.

The number of manufacturing establishments in the United States has doubled—from 253,000 to 513,000.

The value of the output of these establishments has increased two and one-half times, from $5,369,000,000 to more than $13,000,000,000.

The number of employes in these establishments has more than doubled—2,732,000 to 5,719,000. The wages of these employes have almost trebled—$948,000,000 to $2,735,000,000.

Exports of merchandise have increased more than 50 per cent. Exports of agricultural products have increased more than 25 per cent. Exports of manufactures have more than quadrupled.

Imports of all merchandise have increased 30 per cent, but imports per capita have fallen from $12.51 to $10.88.

The production of gold has more than doubled—from $36,000,000 a year to $79,000,000.

The production of silver has nearly doubled—$39,000,000 compared with $74,500,000.

The production of coal has almost quadrupled—64,000,000 tons compared with 241,000,000.

The production of petroleum has nearly trebled—1,100,000,000 gallons compared with 2,661,000,000.

The production of pig iron has nearly quadrupled.

The production of steel has multiplied eight times—1,247,000 tons to 10,188,000.

Prices on steel rails have fallen from $67.50 per ton to $32.29.

The production of copper has increased tenfold—27,000 tons to 270,000.

The production of wool has increased 25 per cent, of wheat 5 per cent, of corn 40 per cent, of cotton 65 per cent, of sugar 60 per cent.

The consumption of sugar has more than doubled—957,000 tons to 2,219,000.

Cotton taken by American mills has doubled, and cotton exported has increased 75 per cent.

Miles of railway in operation have more than doubled—93,262 miles compared with 194,321.

The number of passenger cars has more than doubled—12,788, against 26,786. The number of freight cars has increased two and one-half times—544,000 to 1,358,000.

Tonnage of American vessels built has more than doubled, tonnage engaged in foreign trade has diminished 40 per cent, tonnage engaged in domestic trade has increased 60 per cent and tonnage on the great lakes has multiplied two and one-half times.

Tonnage passing through the Sault Ste. Marie Canal has multiplied seven times.

Freight rates on wheat, Chicago to New York, have fallen from 12.27 cents per bushel to 4.42, lake and canal; from 15.7 cents to 5.05, lake and rail, and from 19.9 cents to 9.98, all rail.

Freight rates per ton mile on all the railways of the United States have dropped from 1.30 cents to 0.75 cents.

The receipts of the federal government have increased from $333,000,000 to $567,000,000.

The number of postoffices in the United States have increased from 44,000 to 77,000.

The receipts of the Postoffice Department have trebled.

The number of telegraphic messages sent in the United States has more than doubled —29,000,000,000 to 63,000,000,000.

The number of newspapers and periodicals published has more than doubled—9,273 to 20,806.

Salaries paid in public schools have more than doubled—$60,000,000 to $136,000,000.

The number of patents issued has almost doubled—14,000 per year to 26,500.

THE PRINCIPAL PLANETS

PLANETS.	Mean Distances from the Sun in Miles.	Mean Diameters in Miles.	Length of Year in Days.	Length of Days in Hours and Minutes. H.	M.
Vulcan	13,082,000	......	24	..	..
Mercury	35,392,000	2,900	88	24	5
Venus	66,131,500	7,510	225	23	21
The Earth..	91,430,220	7,913	365	23	56
Mars	139,312,200	4,920	687	24	37
Jupiter	475,693,100	88,390	4,333	9	56
Saturn	872,134,600	71,900	10,759	10	29
Uranus	1,753,851,000	33,000	30,647	9	30
Neptune ...	2,746,271,200	36,000	60,127	..	..

Jupiter has four moons; Saturn has eight moons and a ring; Uranus has six moons; Neptune has one moon.

Our moon is 2,160 miles in diameter, and is distant 238,650 miles from our earth.

The sun is about 815,000 miles in diameter.

The planets known to the ancients were Mercury, Venus, Mars, Jupiter and Saturn.

The nearest fixed star to our solar system is Cygni No. 61, and this is 210,000,000 times more distant from the sun than we are, or about 20,000,000,000,000,000 miles.

STRENGTH OF VARIOUS SUBSTANCES

With fifty-four inches between supports, a rod of cast iron, one inch square, will break under a load of 550 pounds.

A cube of cast iron, one inch each way, will be crushed under a pressure of 90 tons.

A bar of cast iron, one inch square, will break under a tensile strain of 9½ tons.

These figures show the capacity of best material. Very inferior iron would probably have not over one-half the above resisting power.

The actual cohesive force of different substances is as below, the size of the rod tested being in each case one inch square, and the number of pounds showing the actual breaking strain:

	Lbs.		Lbs.
Hard steel	150,000	Locust wood	20,000
Soft steel	120,000	Cast iron	19,000
Best Swedish iron	84,000	Oak wood	17,000
Ordinary bar iron	70,000	Ivory	16,000
Silver	41,000	Elm wood	13,000
Copper	35,000	Ash wood	12,000
Gold	22,000	Horn	8,750
Whalebone	7,500	Pitch pine wood	7,500
Bone	5,750	Poplar wood	5,500
Tin	5,500	Cedar wood	4,800
Zinc	2,600	Lead	860

THE AVERAGE VELOCITIES OF VARIOUS BODIES

A man walks 3 miles per hour or 4 feet per second.

A horse trots 7 miles per hour or 10 feet per second.

A horse runs 20 miles per hour or 29 feet per second.

Steamboat runs 20 miles per hour or 29 feet per second.

Sailing vessel runs 10 miles per hour or 14 feet per second.

Rapid rivers flow 3 miles per hour or 4 feet per second.

A moderate wind blows 7 miles per hour or 10 feet per second.

A storm moves 36 miles per hour or 52 feet per second.

A hurricane moves 80 miles per hour or 117 feet per second.

A rifle ball moves 1,000 miles per hour or 1,466 feet per second.

Sound moves 743 miles per hour or 1,142 feet per second.

Light moves 192,000 miles per second.

Electricity moves 288,000 miles per second.

HOW TO MIX PAINT FOR TINTS

For brown, mix red and black.

For rose, mix lake and white.

For chestnut, mix white and brown.

For purple, mix white, blue and lake.

For pearl, mix blue and lead color.

For pink, mix white and carmine.

For silver gray, mix indigo and lampblack.

For lead color, mix white and lampblack.

For chocolate, mix black and venetian red.

For bright green, mix white and green.

For French white, mix purple and white.

For dark green, mix light green and black.

For pea green, mix white and green.

For brilliant green, mix white and emerald green.

For orange, mix red and yellow.

For pearl gray, mix white, blue and black.

For flesh color, mix white, lake and vermillion.

For drab, mix umber, white and venetian.

For cream, mix white, yellow and venetian.

For olive, mix red, blue and black.

For buff, mix yellow, white and a little venetian.

UNITED STATES POSTAL REGULATIONS

FIRST-CLASS MAIL MATTER.—*Letters.*—This class includes letters, and anything of which the postmaster cannot ascertain the contents without destroying the wrapper, or anything unsealed which may be wholly or partly in writing—except manuscript for publication accompanied by proof sheets. Postage, two cents each ounce or for each fraction above an ounce. On local or drop letters, at free delivery offices, two cents. At offices where no free delivery by carriers, one cent. Registration fee 8 cents in addition to regular postage.

SECOND-CLASS.—*Regular Publications.*—This class includes all newspapers, periodicals, or matter exclusively in print and regularly issued at stated periods from a known office of publication or news agency. Postage, one cent a pound or fraction thereof, when mailed by the publisher; when mailed by others, one cent for four ounces and every additional fraction thereof.

THIRD CLASS.—*Miscellaneous Printed Matter.*—Mailable matter of third class includes printed books, circulars or other matter wholly in print (not of the second class), proof sheets and manuscript accompanying the same and postage shall be paid at the rate of one cent for each two ounces or fractional part thereof, and shall fully be prepaid by postage stamps affixed to said matter.

All packages of matter of the third class must be so wrapped or enveloped that their contents may be readily and thoroughly examined by postmasters without destroying the wrappers.

FOURTH CLASS.—*Merchandise Samples, etc.*—Mailable matter of the fourth class includes all matter not embraced in the first, second or third classes, which is not in its form or nature liable to destroy, deface or otherwise damage the contents of the mailbag, or harm the person of any one engaged in the postal service.

All matter of the fourth class is subject to a postage charge at the rate of one cent an ounce or fraction thereof, except seeds, roots, cuttings, bulbs and the like, on which the rate is one cent for two ounces, and all must be fully prepaid.

POSTAL CARDS.—Postal cards are sold at a fixed rate of one cent (and two cents for foreign) each, in any quantity. Unclaimed postal cards are never returned to the writer. Anything pasted on or attached to a postal card subjects it to letter postage.

MONEY ORDERS.—Domestic orders are sold at the following rates: Not exceeding $2.50, 3 cents; not exceeding $5, 5 cents; not exceeding $10, 8 cents; not exceeding $20, 10 cents; not exceeding $30, 12 cents; not exceeding $40, 15 cents; not exceeding $50, 18 cents; not exceeding $60, 20 cents; not exceeding $75, 25 cents; not exceeding $100, 30 cents.

REGISTRY FEE on domestic or foreign letters and packages, in addition to fully prepaid postage, is 8 cents.

FOREIGN POSTAGE.—Rates to Canada and Mexico are the same as in the United States. To all other countries in the Postal

Union, letters 5 cents for each half ounce, printed matter 1 cent for each 2 ounces.

CENTER OF POPULATION IN THE UNITED STATES

The manner in which settlement has progressed westward is graphically shown by the census returns, which indicate every ten years the actual center of our national population. There is surprisingly little variation in the line of advance, either north or south, showing that emigration generally follows parallels of latitude instead of making radical changes of climate. The center of population at various dates has been as follows:

		Westward Movement
1790.	23 miles east of Baltimore, Md.	
1800.	18 miles west of Baltimore, Md....	41 miles
1810.	40 miles northwest of Washington, D. C.	36 miles
1820.	16 miles north of Woodstock, Va..	50 miles
1830.	19 miles southwest of Moorefield, W. Va.	39 miles
1840.	16 miles south of Clarksburg, W. Va.	55 miles
1850.	23 miles southeast of Parkersburg, W. Va.	55 miles
1860.	20 miles south of Chillicothe, O...	81 miles
1870.	48 miles northeast of Cincinnati, O.	42 miles
1880.	8 miles southwest of Cincinnati, O.	58 miles
1890.	20 miles east of Columbus, Ind....	48 miles
1900.	6 miles southeast of Columbus, Ind.	14 miles

PUBLIC LANDS IN THE UNITED STATES

FROM THE STATEMENT OF THE DEPARTMENT OF THE INTERIOR.

	Surveyed.	Unsurveyed.	Total.
Alabama	359,250		359,250
Alaska		359,492,760	359,492,760
Arizona	10,886,745	39,400,241	50,286,986
Arkansas	3,493,444		3,493,444
California	34,423,923	8,043,589	42,467,512
Colorado	35,134,613	4,515,634	39,650,247
Florida	1,438,749	157,662	1,596,411
Idaho	11,722,541	31,564,153	43,286,694
Kansas	1,196,900		1,196,900
Louisiana	377,206	65,018	442,224
Michigan	430,483		430,483
Minnesota	2,386,295	2,309,908	4,696,203
Mississippi	285,804		285,804
Missouri	337,946		337,946
Montana	18,546,146	49,416,911	67,963,057
Nebraska	9,798,688		9,798,688
Nevada	29,622,658	31,654,848	61,277,507
N. Mexico	41,951,628	14,589,542	56,541,170
N. Dakota	12,597,130	6,128,109	18,725,239
Oklahoma	5,733,572		5,733,572
Oregon	23,489,861	10,888,046	34,377,907
S. Dakota	11,612,943	317,866	11,930,809
Utah	10,019,262	32,948,189	42,967,451
Washington	5,237,302	5,888,581	11,125,883
Wisconsin	313,565		313,565
Wyoming	43,194,311	5,163,858	48,358,169
Grand Total	314,509,965	602,544,915	917,135,880

Excluding Alaska there is in the United States alone, wholly unoccupied land, more than half of which is good for cultivation or grazing, amounting in extent to about one-fourth the entire area.

NATIONAL PARK RESERVES IN THE UNITED STATES

	Date of Reservation.	Area Acres.
California, Yosemite National Park	Oct. 1, 1890	967,680
Sequoia National Park	Sept. 25, 1890	161,280
General Grant National Park		2,560
Washington, Mount Rainier National Park	Mar. 2, 1899	207,360
Wyoming, Yellowstone National Park	Mar. 1, 1872	2,142,720
Maryland, Antietam National Military Park	Aug. 30, 1890	
Mississippi, Vicksburg National Military Park	Feb. 21, 1899	
Pennsylvania, Gettysburg National Military Park	Feb. 11, 1895	
Tennessee, Chickamauga and Chattanooga National Military Park	Aug. 19, 1890	
Shiloh National Military Park	Dec. 27, 1894	
Arkansas, Hot Springs of Garland County	1832, 1877, 1880	912
Arizona, Casa Grande Ruin	June 22, 1892	480

GRAIN PRODUCTION OF UNITED STATES IN BUSHELS

	Indian Corn.	Wheat.
1890	1,489,970,000	339,262,000
1895	2,151,138,580	467,102,947
1900	2,105,102,516	522,229,505

	Oats.	Barley.	Rye.
1890	532,621,000	67,168,344	25,807,472
1895	824,443,537	87,072,744	27,210,070
1900	809,125,989	58,925,833	23,995,927

NUMBER OF FARM ANIMALS IN THE UNITED STATES

	Horses.	Mules.	Sheep.
1890	14,213,837	2,331,027	44,336,072
1893	16,206,802	2,331,128	47,273,553
1896	15,124,057	2,278,946	38,298,783
1900	13,537,524	2,086,027	41,883,005

	Swine.	Milk Cows.	Beeves.
1890	51,602,780	15,952,883	36,849,024
1893	46,094,807	16,424,087	35,954,196
1896	42,842,759	16,137,586	32,085,409
1900	38,321,547	16,292,360	27,610,054

NUMBER OF FARM ANIMALS IN THE VARIOUS STATES, 1901

States and Territories.	Horses.	Mules.	Milch cows.
Maine	111,987	....	197,878
N. Hampshire	55,028	....	136,825
Vermont	84,812	....	271,602
Massach'ts	63,478	....	179,791
Rhode Island	10,281	....	25,511
Connecticut	43,682	....	143,098
New York	596,738	4,421	1,458,251
New Jersey	79,180	7,269	214,674
Pennsylvania	548,747	37,053	924,260
Delaware	30,883	4,928	35,376
Maryland	129,662	12,638	155,022
Virginia	233,940	35,998	244,937
N. Carolina	146,697	111,398	248,263
S. Carolina	66,979	97,357	126,762
Georgia	110,266	158,594	297,324
Florida	37,673	8,354	114,251
Alabama	132,224	129,726	254,727
Mississippi	201,477	163,082	256,951
Louisiana	143,593	90,904	125,747
Texas	1,137,015	265,880	700,802
Arkansas	234,596	145,504	196,808
Tennessee	317,601	151,265	254,675
W. Virginia	151,847	7,412	163,895
Kentucky	365,602	106,547	248,208
Ohio	653,499	17,228	736,735
Michigan	410,410	2,646	459,107
Indiana	601,271	41,650	611,975
Illinois	1,003,299	82,225	1,001,212
Wisconsin	409,822	4,754	895,822
Minnesota	455,122	8,416	646,673
Iowa	981,352	31,547	1,250,775
Missouri	762,734	183,362	673,195
Kansas	734,881	79,410	680,457
Nebraska	652,284	43,016	628,750
S. Dakota	290,746	6,693	372,321
N. Dakota	175,137	7,036	171,073
Montana	164,923	924	43,994
Wyoming	72,258	1,514	18,140
Colorado	146,687	8,667	91,666
N. Mexico	83,351	3,472	19,317
Arizona	50,414	1,041	18,404
Utah	68,295	1,599	57,787
Nevada	44,305	1,384	18,069
Idaho	128,077	917	31,500
Washington	169,694	1,441	115,485
Oregon	185,844	5,609	116,581
California	342,265	52,915	318,425
Oklahoma	42,649	8,407	37,014
Total	13,665,307	2,134,213	15,990,115

States and Territories.	Other cattle.	Sheep.	Swine.
Maine	109,440	246,628	75,306
N. Hampshire	79,380	78,289	56,104
Vermont	133,788	165,940	76,208
Massachusetts	74,875	40,437	54,846
Rhode Island	10,356	10,715	13,722
Connecticut	66,588	31,745	54,165
New York	561,077	841,955	645,237
New Jersey	41,558	42,299	151,120
Pennsylvania	528,942	790,604	1,043,331
Delaware	22,995	12,981	50,556
Maryland	105,900	136,135	331,853
Virginia	338,542	369,227	917,550
North Carolina	295,530	261,400	1,369,703
South Carolina	141,509	66,540	1,041,462
Georgia	423,018	327,584	2,093,987
Florida	325,774	83,598	429,128
Alabama	336,479	193,033	1,866,640
Mississippi	304,118	239,720	1,957,399
Louisiana	182,690	119,163	796,498
Texas	4,533,897	2,543,917	2,684,987
Arkansas	250,528	119,733	1,280,120
Tennessee	322,293	286,063	1,570,154
West Virginia	243,460	440,014	331,563
Kentucky	341,181	597,643	1,357,765
Ohio	636,433	2,730,471	2,307,051
Michigan	341,535	1,396,053	735,035
Indiana	641,913	674,532	1,340,231
Illinois	1,265,066	613,191	2,008,265
Wisconsin	589,315	722,967	929,763
Minnesota	570,165	410,998	411,353
Iowa	2,163,584	613,343	3,408,281
Missouri	1,460,647	616,102	2,949,818
Kansas	2,076,489	231,192	1,591,341
Nebraska	1,395,829	292,779	1,353,671
South Dakota	449,362	363,697	145,469
North Dakota	252,640	359,721	111,959
Montana	952,598	3,377,547	42,265
Wyoming	694,973	2,328,025	22,345

States and Territories.	Other cattle.	Sheep.	Swine.
Colorado	973,259	1,655,551	20,713
New Mexico	701,967	3,128,692	30,204
Arizona	381,812	1,014,287	23,286
Utah	303,116	2,116,949	47,808
Nevada	224,317	576,994	10,441
Idaho	384,056	2,311,880	75,718
Washington	265,376	759,824	156,748
Oregon	573,646	2,575,468	216,430
California	664,704	2,175,545	374,141
Oklahoma	257,505	22,982	89,891
Total	27,994,225	39,114,453	38,651,631

HOGS PACKED AND MARKETED, YEAR ENDING MARCH 1, 1901

Cities.	Number of Hogs.
Chicago	7,268,515
Kansas City	2,981,288
Omaha	2,241,599
St. Louis	1,566,550
Indianapolis	1,185,600
Cincinnati	617,031
Milwaukee and Cudahy	911,256
St. Joseph	1,723,377
Cedar Rapids	496,308
Ottumwa	653,785
Cleveland	500,785
Louisville	360,425
Sioux City	733,754
St. Paul	514,385
Nebraska City	114,962
Other Places West	1,731,053
Boston	1,370,000
Buffalo	343,000
Other Places East	1,046,000
Receipts at New York, Philadelphia, and Baltimore	2,620,000
Total 1901	28,980,000
Total 1900	28,172,000

WORLD'S PRODUCTION OF WHEAT IN BUSHELS, FOR 1901

United States	522,229,505
Russian Empire	458,084,000
France and Colonies (Algeria and Tunis)	338,383,000
Austria-Hungary	189,650,000
India	182,582,000
Germany	141,139,000
Italy	119,750,000
Spain	105,000,000
Argentina	101,266,000
British Isles	57,065,000
Rumania	56,463,000
Australasia	50,110,000
Turkey (European and Asiatic)	50,000,000
Canada	44,542,000
Bulgaria	30,000,000
Japan	20,000,000
Persia	16,000,000
Mexico	15,000,000
Egypt	14,000,000
Belgium	12,000,000
Chile	12,000,000
Servia	10,000,000
Portugal	8,000,000
Uruguay	6,891,000
Rest of the World	25,869,495
Total World's Production	2,586,025,000

THE WORLD'S PRODUCTION OF WOOL IN 1901

Countries.	Pounds.
North America:	
United States	302,502,328
British Provinces	12,000,000
Mexico	5,000,000
Total	319,502,328
Central America and West Indies	5,000,000
South America:	
Argentina	370,000,000
Brazil	1,500,000
Chile	7,500,000
Uruguay	96,000,000
Venezuela	15,000,000
All other South America	20,000,000
Total	510,000,000
Europe:	
Great Britain and Ireland	141,146,376
France	103,610,000
Spain	102,600,000
Portugal	13,410,000
Germany	49,590,000
Italy	21,451,000
Austria-Hungary	64,300,000
Russia, including Poland	361,100,000
Sweden and Norway	8,200,000
Turkey and Balkan Peninsula	67,500,000
All other Europe	14,000,000
Total	946,907,376
Asia:	
Russia	60,000,000
Central Asia	46,000,000
British India	85,000,000

Asia—Continued	Pounds.
Asiatic Turkey	33,000,000
China	35,000,000
All other Asia	15,000,000
Total	274,000,000

Africa:	
Algeria and Tunis	30,425,000
Cape Colony, Natal, Orange Free State	100,000,000
Egypt	3,000,000
All other Africa	1,000,000
Total	134,425,000
Australasia	510,000,000
Oceanica	50,000
Grand Total	2,699,884,704

CANE AND BEET SUGAR OF THE WORLD

The following was the production of sugar in 1899-1900 by principal sugar-growing countries, in tons of 2,240 pounds:

Countries.	Cane Sugar.
Louisiana	132,000
Porto Rico	50,000
Cuba	395,000
British West Indies	134,000
Haiti and Santo Domingo	55,000
Peru	100,000
Brazil	175,000
Java	722,000
Hawaii	275,000
Queensland	122,500
Mauritius	155,000
British Guiana	80,000
Argentina	90,000
Philippines	40,000

Countries.	Beet Sugar.
United States	72,944
Germany	1,790,000
Austria	1,120,000
France	970,000
Russia	900,000
Belgium	300,000
Holland	100,000

POUNDS PER BUSHEL

The following are minimum weights of certain articles of produce according to the laws of the United States:

	Per Bushel.
Wheat	60 lbs.
Corn, in the ear	70 "
Corn, shelled	56 lbs.
Rye	56 "
Buckwheat	48 "
Barley	48 "
Oats	32 "
Peas	60 "
White Beans	60 "
Castor Beans	46 "
White Potatoes	60 "
Sweet Potatoes	55 "
Onions	57 "
Turnips	55 "
Dried Peaches	33 "
Dried Apples	26 "
Clover Seed	60 "
Flax Seed	56 "
Millet Seed	50 "
Hungarian Grass Seed	50 "
Timothy Seed	45 "
Blue Grass Seed	44 "
Hemp Seed	44 "
Corn Meal	48 "
Ground Peas	24 "
Malt	34 "
Bran	20 "

Salt.—Weight per bushel as adopted by different States ranges from 50 to 80 pounds. Coarse salt in Pennsylvania is reckoned at 80 pounds, and in Illinois at 50 pounds per bushel. Fine salt in Pennsylvania is reckoned at 62 pounds, in Kentucky and Illinois at 55 pounds per bushel.

COMPARATIVE YIELD OF VARIOUS KINDS OF VEGETABLES

(Productions in Pounds Weight per Acre.)

Vegetables.	Lbs. per acre.	Vegetables.	Lbs. per acre.
Hops	442	Grass	7,000
Wheat	1,260	Carrots	6,800
Barley	1,600	Potatoes	7,500
Oats	1,840	Apples	8,000
Peas	1,920	Turnips	8,420
Beans	2,000	Cinque-foil grass	9,600
Plums	2,000	Vetches, green	9,800
Cherries	2,000	Cabbages	10,900
Onions	2,800	Parsnips	11,200
Hay	4,000	Mangel Wurtzel	22,000
Pears	5,000		

One acre will produce 224 lbs. mutton, 186 lbs. beef, 2,900 lbs. milk, 300 lbs. butter, and 200 lbs. cheese. A fair crop of potatoes from 16 bushels of seed is 340 bushels.

AGES TO WHICH ANIMALS LIVE

Animal.	Years.	Animal.	Years.
Whale	1,000	Tortoise	100
Elephant	400	Eagle	100
Swan	300	Raven	100

Animal.	Years.	Animal.	Years.
Camel	100	Swine	20
Lion	70	Wolf	20
Porpoise	20	Cat	15
Horse	20	Fox	15
Bear	20	Dog	15
Cow	20	Sheep	10
Deer	20	Rabbit	7
Rhinoceros	20	Squirrel	7

VALUE OF FOREIGN COINS, (July 1, 1899)

Prepared by the Director of the Mint. G, Gold standard. S, Silver standard. G and S, Gold and Silver standard, generally at 15 1-2 or 16 to 1.

Countries.	Monetary Unit.	Value Oct. 1, 1898
Argentina, G. and S.	Peso	$.96.5
Austria-Hungary, G.	Crown	.20.3
Belgium, G. and S.	Franc	.19.3
Bolivia, S.	Boliviano	.44.3
Brazil, G.	Milreis	.54.6
British Possessions, N. A. (except Newfoundland) G.	Dollar	1.00.0
Central Am. States— Costa Rica, G.	Colon	.44.3
Guatemala, Salvador, Honduras, Nicaragua S.	Peso	.44.3
Chile, G. and S.	Peso	.36.5
China, S.	Tael. Amoy	.71.6
	Canton	.71.4
	Chefoo	.68.4
	Chin Kiang	.69.9
	Fuchau	.66.2
	Haikwan (customs)	.72.8
	Hankow	.67.0
	Niuchwang	.67.1
	Ningpo	.68.8
	Shanghai	.65.4
	Tientsin	.69.4
Colombia, S.	Peso	.44.3
Cuba, G. and S.	Peso	.92.6
Denmark, G.	Crown	.26.8
Ecuador, S.	Sucre	.44.3
Egypt, G.	Pound, 100 piasters	4.94.3
Finland, G.	Mark	.19.3
France, G. and S.	Franc	.19.3
German Empire, G.	Mark	.23.8
Great Britain, G.	Pound sterling	4.86.6½
Greece, G. and S.	Drachma	.19.3
Haiti, G. and S.	Gourde	.96.5
India, S.	Rupee	.21.0
Italy, G. and S.	Lira	.19.3
Japan, G. and S.	Yen	.49.8
Liberia, G.	Dollar	1.00.0
Mexico, S.	Dollar	.48.1
Netherlands, G. and S.	Florin	.40.2
Newfoundland, G.	Dollar	1.01.4
Norway, G.	Crown	.26.8
Persia, S.	Kran	.08.2
Peru, S.	Sol	.44.3
Portugal, G.	Milreis	1.08.0
Russia, G. and S.	Ruble	.51.5
Spain, G. and S.	Peseta	.19.3
Sweden, G.	Crown	.26.8
Switzerland, G. and S.	Franc	.19.3
Turkey, G.	Piaster	.04.4
Uruguay, G.	Peso	1.03.4
Venezuela, G. and S.	Bolivar	.19.3

AVERAGE OF WEALTH FOR EACH INHABITANT

	Rural.	Urban.	Total.	Real.	Personal
United Kingdom	$265	$1,245	$1,510	$530	$980
France	400	860	1,260	615	645
Germany	240	540	780	360	420
Russia	130	175	305	150	155
Italy	225	280	505	265	240
Denmark	575	575	1,150	620	530
Holland	305	610	915	435	480
Belgium	280	490	770	375	395
Switzerland	285	535	820	380	440
All Europe	180	470	695	320	375
United States	295	875	1,170	555	615
Canada	300	680	980	365	615
Average for world	240	535	775	355	420

CONSUMPTION OF LIQUOR THROUGHOUT THE WORLD

(Figures represent the average consumption per capita.)

	Wine.	Beer.	Spirits.
United Kingdom	0.4	30.0	1.0
France	26.0	5.0	1.9
Germany	1.2	24.0	1.9
Russia	0.4	0.9	1.1
Austria	3.1	9.0	2.3
Italy	20.5	0.1	0.3
Spain	18.0	1.4	...
Scandinavia	0.2	9.5	2.0
Holland	0.4	10.5	2.0
Belgium	0.9	41.5	2.1
Switzerland	15.0	11.5	1.3
United States	0.3	12.8	1.1

ANNIVERSARIES

DATES OF HISTORICAL EVENTS CUSTOMARILY OR OCCASIONALLY OBSERVED.

Jan. 1. Emancipation Proclamation by Lincoln, 1863.
Jan. 8. Battle of New Orleans, 1815.
Jan. 17. Franklin born, 1706.
Jan. 17. Battle of the Cowpens, S. C., 1781.
Jan. 18. Daniel Webster born, 1782.
Jan. 19. Robert E. Lee born, 1807.
Jan. 27. German Emperor born, 1859.
Feb. 12. Abraham Lincoln born, 1809.
Feb. 15. Battleship Maine blown up, 1898.
Feb. 22. George Washington born, 1732.
Feb. 22-23. Battle of Buena Vista, 1847.
March 5. Boston Massacre, 1770.
March 15. Andrew Jackson born, 1767.
March 18. Grover Cleveland born, 1837.
April 1. Bismarck born, 1815.
April 9. Lee surrendered at Appomattox, 1865.
April 12. Fort Sumter fired upon, 1861.
April 12. Henry Clay born, 1777.
April 13. Thomas Jefferson born, 1743.
April 14. Lincoln assassinated, 1865.
April 19. Primrose Day in England, Lord Beaconsfield died, 1881.
April 19. Battles of Lexington and Concord, 1775.
April 23. Shakespeare born, 1564.
April 27. General Grant born, 1822.
April 30. Washington was inaugurated first President, 1789.
May 1. Dewey destroyed the Spanish fleet at Manila, 1898.
May 13. First English settlement in America, at Jamestown, 1607.
May 13. The Society of the Cincinnati was organized by officers of the Revolutionary Army, 1783.
May 20. Mecklenburg, N. C., Declaration of Independence, 1775.
May 24. Queen Victoria born, 1819.
June 6. General Nathanael Greene born, 1742.
June 15. King John granted Magna Charta at Runnymede, 1215.
June 17. Battle of Bunker Hill, 1775.
June 18. Battle of Waterloo, 1815.
June 28. Battle of Fort Moultrie, Charleston, S. C., 1776.
July 1. Dominion Day in Canada.
July 1-2. General assault on Santiago de Cuba, 1898.
July 1-3. Battle of Gettysburg, 1863.
July 3. Cervera's fleet was destroyed off Santiago, 1898, by fleet under Admiral Schley.
July 4. Declaration of Independence, 1776.
July 14. The Bastile was destroyed, 1789.
July 16. Santiago surrendered, 1898.
July 21. Battle of Bull Run, 1861.
Aug. 13. Manila surrendered to the Americans, 1898.
Aug. 16. Battle of Bennington, Vt., 1777.
Sept. 1. Capitulation of Sedan, 1870.
Sept. 8. Battle of Eutaw Springs, S. C., 1781.
Sept. 10. Battle of Lake Erie, Perry's victory, 1813.
Sept. 11. Battle of Lake Champlain, McDonough's victory, 1814.
Sept. 13. Battle of Chapultepec, 1847.
Sept. 14. City of Mexico taken by the U.S. troops, 1847.
Sept. 17. Battle of Antietam, 1862.
Sept. 19-20. Battle of Chickamauga, 1863.
Sept. 20. Italians occupied Rome, 1870.
Oct. 7. Battle of King's Mountain, N. C., 1780.
Oct. 8-11. Great fire of Chicago, 1871.
Oct. 12. Columbus discovered America, 1492.
Oct. 17. Burgoyne surrendered at Saratoga, 1777.
Oct. 19. Cornwallis surrendered at Yorktown, 1781.
Nov. 5. Guy Fawkes Day in England. The Gunpowder Plot discovered, 1604.
Nov. 9. Great fire of Boston, 1872.
Nov. 10. Martin Luther born, 1483.
Nov. 25. British evacuated New York, 1783.
Dec. 2. Battle of Austerlitz, 1805.
Dec. 14. Washington died, 1799.
Dec. 16. Boston "Tea Party," 1773.
Dec. 16. The great fire in New York, 1835.
Dec. 22. Mayflower pilgrims landed at Plymouth Rock, 1620.
Dec. 25-26. Battle of Trenton, N. J., 1776.
Dec. 29. William Ewart Gladstone born, 1809.

TABLE OF MEMORABLE DATES

B. C.

1183 Fall of Troy.
1082 Era of the Great Pyramid.
878 Carthage founded.
776 Olympic Era began.
753 Foundation of Rome.
588 Jerusalem taken by Nebuchadnezzar.
536 Restoration of the Jews under Cyrus.
509 Expulsion of Tarquin from Rome.
480 Xerxes defeated Greeks at Thermopylæ.
55 Cæsar conquered Britain.
4 Birth of Jesus Christ.

A. D.

29 The Crucifixion.
70 Jerusalem was destroyed by Titus.
313 Constantine converted to Christianity.
410 The Romans abandoned Britain.
827 Egbert, first king of all England, Oct. 14.,
1066 Battle of Hastings. Norman Conquest.
1096 The Crusades began.
1172 Ireland was conquered by Henry II.
1215 King John granted Magna Charta, June 15.
1265 First Representative Parliament in England.
1415 Battle of Agincourt, Oct. 25.
1431 Joan of Arc was burnt, May 30.
1453 Constantinople taken by the Turks.
1455 The Wars of the Roses began.
1462 The Bible was first printed at Mentz.
1471 Caxton set up his printing press.
1486 The feuds of York and Lancaster ended.
1492 Columbus discovered America, Oct. 12.
1517 The Reformation began in Germany.
1519 Cortez began the conquest of Mexico.
1535 The first English Bible printed.

Animal.	Years.	Animal.	Years.
Camel	100	Swine	20
Lion	70	Wolf	20
Porpoise	30	Cat	15
Horse	20	Fox	15
Bear	20	Dog	10
Cow	20	Sheep	10
Deer	20	Rabbit	7
Rhinoceros	20	Squirrel	7

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Costa Rica, G.	Colon	.44.3
Guatemala, Salvador, Honduras, Nicaragua S.	Peso	.44.3
Chile, G. and S.	Peso	.36.5
China, S.	Tael. Amoy	.71.6
	Canton	.71.4
	Chefoo	.68.4
	Chin Kiang	.69.9
	Fuchau	.66.2
	Haikwan (customs)	.72.8
	Hankow	.67.0
	Niuchwang	.67.1
	Ningpo	.68.8
	Shanghai	.65.4
	Tientsin	.69.4
Colombia, S.	Peso	.44.3
Cuba, G. and S.	Peso	.92.6
Denmark, G.	Crown	.26.8
Ecuador, S.	Sucre	.44.3
Egypt, G.	Pound, 100 piasters	4.94.3
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France, G. and S.	Franc	.19.3
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Haiti, G. and S.	Gourde	.96.5
India, S.	Rupee	.21.0
Italy, G. and S.	Lira	.19.3
Japan, G. and S.	Yen	.49.8
Liberia, G.	Dollar	1.00.0
Mexico, S.	Dollar	.48.1
Netherlands, G. and S.	Florin	.40.2
Newfoundland, G.	Dollar	1.01.4
Norway, G.	Crown	.26.8
Persia, S.	Kran	.08.2
Peru, S.	Sol	.44.3
Portugal, G.	Milreis	1.08.0
Russia, G. and S.	Ruble	.51.5
Spain, G. and S.	Peseta	.19.3
Sweden, G.	Crown	.26.8
Switzerland, G. and S.	Franc	.19.3
Turkey, G.	Piaster	.04.4
Uruguay, G.	Peso	1.03.4
Venezuela, G. and S.	Bolivar	.19.3

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Russia	0.4	0.9	
Austria	3.1	9.0	
Italy	20.5	0.1	
Spain	18.0	1.4	
Scandin[illegible]	0.2	[illegible]	
Holl[illegible]			
B[illegible]			
S[illegible]			
[illegible]			

States and Territories.	Number of Men Furnished.	Aggregate Reduced to a Three Years Standard.
Michigan	87,364	80,111
Minnesota	24,020	19,693
Mississippi	545	545
Missouri	109,111	86,530
Nebraska	3,157	2,175
Nevada	1,080	1,080
New Hampshire	33,937	30,849
New Jersey	76,814	57,908
New York	448,850	392,270
North Carolina	3,156	3,156
Ohio	313,180	240,514
Oregon	1,810	1,773
Pennsylvania	337,936	265,517
Rhode Island	23,236	17,878
Tennessee	31,092	26,394
Texas	1,965	1,632
Vermont	33,288	29,068
West Virginia	32,068	27,714
Wisconsin	91,327	79,260
Dakota	206	206
District of Columbia	16,534	11,506
Indian Territory	3,530	1,530
New Mexico	6,561	4,432
Washington	964	964
U. S. Colored Troops	93,441	91,789
Total	2,778,304	2,326,168

The number of casualties in the volunteer and regular armies of the United States, during the war of 1861-65, according to a statement prepared by the Adjutant-General's office, was as follows: Killed in battle, 67,058; died of wounds, 43,012; died of disease, 199,720; other causes, such as accidents, murder, Confederate prisons, etc., 40,154; total died, 349,944; total deserted, 199,045. Number of soldiers in the Confederate service who died of wounds or disease (partial statement), 133,821. Deserted (partial statement), 104,428. Number of United States troops captured during the war, 212,608; Confederate troops captured, 476,169. Number of United States troops paroled on the field, 16,431; Confederate troops paroled on the field, 248,599. Number of United States troops who died while prisoners, 30,156; Confederate troops who died while prisoners, 30,152.

WARS OF THE UNITED STATES

STATEMENT OF THE NUMBER OF UNITED STATES TROOPS ENGAGED

War of the Revolution, from April 19, 1775, to April 11, 1783; regulars, 130,711; militia and volunteers, 164,080; total, 309,791.

Northwestern Indian Wars, from Sept. 19, 1790, to Aug. 3, 1795; total, 8,983.

War with France, from July 9, 1798, to Sept. 30, 1800; total, 4,593.

War with Tripoli, from June 10, 1801, to June 4, 1805; total, 3,330.

Creek Indian War, from July 27, 1813, to Aug. 9, 1814; regulars, 600; militia and volunteers, 13,181; total, 13,781.

War of 1812 with Great Britain, from June 18, 1812, to Feb. 17, 1815; regulars, 85,000; militia and volunteers, 471,622; total, 576,622.

Seminole Indian War, from Nov. 20, 1817, to Oct. 21, 1818; regulars, 1,000; militia and volunteers, 6,911; total, 7,911.

Black Hawk Indian War, from April 21, 1831, to Sept. 30, 1832; regulars, 1,339; militia and volunteers, 5,126; total, 6,465.

Cherokee disturbance or removal, from 1836 to 1837; militia and volunteers, 9,494; total, 9,494.

Creek Indian War or disturbance, from May 5, 1836, to Sept. 30, 1837; regulars, 935; militia and volunteers, 12,483; total, 13,418.

Florida Indian War, from Dec. 23, 1835, to Aug. 14, 1843; regulars, 11,169; militia and volunteers, 29,953; total, 41,122.

Aroostook disturbance, from 1836 to 1839; militia and volunteers, 1,500; total, 1,500.

War with Mexico, from April 24, 1846, to July 4, 1848; regulars, 30,954; militia and volunteers, 73,776; total, 112,230.

Apache, Navajo, and Utah War, from 1849 to 1855; regulars, 1,500; militia and volunteers, 1,061; total, 2,561.

Seminole Indian War, from 1856 to 1858; militia and volunteers, 3,687; total, 3,687.

Civil War, from 1861 to 1865; total, 2,772,408.

Spanish-American War, from April 21, 1898, to Aug. 13, 1898; total, 274,717.

War in the Philippines, from 1899 to 1902; total, 153,000.

* Including all branches of the service. † Naval forces engaged. ‡ The number of troops on the Confederate side was about 600,000. § Troops actually engaged, about 60,000.

NUMBER OF PENSIONERS ON ROLLS AND AMOUNT OF PENSIONS

1895	970,524	$140,959,361.37
1900	993,529	138,462,130.65

MILITARY RESOURCES OF EUROPE IN ABLE-BODIED MEN

Nations.	Population Capable of Bearing Arms.*
Austria	9,800,000
Belgium	1,460,000
Denmark	490,000
France	9,550,000
Germany	12,000,000
Great Britain†	12,000,000
Greece	495,000
Italy	7,500,000
Netherlands	1,050,000
Portugal	1,170,000
Russia‡	22,000,000
Spain	4,200,000
Sweden and Norway	1,600,000
Switzerland	720,000

* Inclusive of persons engaged in the general and local civil administration, railroads, necessary tillers of the soil, and others who would not be spared to the field except as a last resort. † Great Britain includes Canada and Australia, but not other colonies or India. ‡ Russian population in Europe only is considered.

GREAT LIBRARIES OF THE WORLD

	No. of Volumes.
National, Paris	2,500,000
British Museum, London	1,600,000
Imperial, St. Petersburg	1,000,000
Munich	1,000,000
Berlin	800,000
Library of Congress, Washington*	680,000
Public, Boston*	560,000
Darmstadt	550,000
Leipsic	550,000
Strasburg	525,000
Royal, Copenhagen	500,000
Imperial, Vienna	450,000
Bodleian, Oxford	450,000
Public, St. Petersburg	440,000
Stuttgart	430,000
Gottingen	425,000
National, Florence	425,000
Madrid	410,000
Buda-Pest	400,000
University of Chicago*	380,000
Harvard University*	300,000
Heidelberg	300,000
Astor, New York*	240,000
Vatican, Rome	225,000

*Exclusive of pamphlets. The Harvard University Library has 278,000, and the Library of Congress 210,000 pamphlets.

ILLITERACY STATISTICS

Illiterates, in the sense here signified, are those above 21 years of age who cannot read and write. The following tables show the number of such in seven great cities of the United States, and in representative states standing high and low in the scale. The proportions of native and foreign born, and white and colored are indicated. The percentages are based on the relation of the number of illiterates to the whole of the population above 21 years of age.

	Total illiterate.	Native born	Foreign born	Total white	Total colored	Per cent of illiteracy.
New York City	65,556	3,028	62,528	62,889	2,717	6.5
Chicago	20,572	1,236	19,336	19,649	682	4.0
Philadelphia	17,588	3,695	13,893	14,847	2,741	4.5
St. Louis	7,026	3,337	3,689	4,596	2,430	4.1
Boston	8,111	410	7,701	7,481	630	4.0
Baltimore	10,152	7,034	3,118	4,182	5,970	7.2
Cleveland	5,786	440	5,346	5,522	264	5.2
In certain states least in per cent of illiteracy:						
Wyoming	1,636	657	979	1,040	596	4.3
Utah	2,470	1,163	1,307	1,619	851	3.7
South Dakota	5,442	3,208	2,234	2,693	2,749	4.8
Oregon	6,978	1,958	5,020	2,160	4,818	4.8
Ohio	58,698	36,986	21,712	51,769	6,929	4.8
Nebraska	7,388	2,668	4,720	6,841	547	2.5
Minnesota	20,785	4,005	16,780	19,223	1,562	4.1
Kansas	14,214	9,891	4,323	9,846	4,368	3.4
Colorado	7,689	3,885	3,804	6,847	842	4.1
Iowa	17,061	8,788	8,273	15,981	1,080	2.7
Greatest in per cent of illiteracy:						
Louisiana	122,638	116,087	6,551	32,039	90,599	37.6
West Virginia	32,066	29,162	2,904	26,472	5,594	12.9
Virginia	113,353	112,090	1,263	36,493	76,860	25.3
Texas	113,783	91,545	22,238	51,790	61,993	15.4
Tennessee	105,851	105,078	773	52,418	53,433	21.7
South Carolina	99,516	99,322	194	15,865	18,651	35.1
North Carolina	122,658	122,496	162	54,474	68,184	29.4
New Mexico	15,585	13,275	2,310	12,504	3,081	28.3
Nevada	2,271	1,490	781	475	1,796	12.8
Mississippi	118,054	117,509	545	12,472	105,582	33.8
Maryland	40,352	35,639	4,713	15,678	24,674	12.5
Kentucky	102,578	100,340	2,188	65,517	37,011	18.8
Indian T'y	15,482	14,970	512	8,477	7,005	15.9
Hawaii	27 363	722	26,641	3,335	24,028	34.4
Georgia	158,247	157,764	483	32,456	125,791	31.6
Florida	30,849	29,460	1,389	6,558	24,291	22.1
Delaware	7,538	6,332	1,206	3,945	3,593	14.0
Arkansas	62,615	62.049	566	23,523	39,092	20.0
Arizona	10,533	6,327	4,206	4,776	5,757	23.9
Alaska	10,735	7,655	3,080	584	10,151	28.3
Alabama	139,649	138,934	715	31,614	108,035	33.7

HEIGHTS OF WATERFALLS

	Feet.
Cerosola Cascade, Alps	2,400
Yosemite Falls, California	1,500
Falls of Arne, Savoy	1,100
Virgin Tears Creek, Yosemite	1,000

	Feet.
Bridal Veil, Yosemite	900
Lauterbaum, Switzerland	900
Falls of Terni, near Rome	300
Montmorency Falls, Quebec	250
Fryer's Falls, Scotland	200
Niagara Falls, North America	164
Lidford Cascade, England	100

RELIGIONS AND DENOMINATIONS OF THE WORLD

Creeds.	No. of Adherents.
Christianity	477,080,158
Confucianism	256,000,000
Hindooism	190,000,000
Mohammedanism	176,834,372
Buddhism	147,900,000
Taoism	43,000,000
Shintoism	14,000,000
Judaism	7,186,000
Polytheism	117,681,669

CHRISTIANITY.

Catholic Church	230,866,533
Protestant Churches	143,237,625
Orthodox Greek Church	98,016,000
Church of Abyssinia	3,000,000
Armenian Church	1,690,000
Coptic Church	120,000
Nestorians	80,000
Jacobites	70,000
Total	477,080,158

STATISTICS OF CHURCHES IN THE UNITED STATES.

Denominations.	Churches.	Ministers.	Communicants.
Adventists:			
Evangelical	34	30	1,147
Advent Christian	883	580	25,816
Seventh-Day	372	1,470	55,316
Church of God	19	29	647
Life and Advent Union	60	33	3,000
Church of God in Jesus Christ	94	95	2,872
Armenians	15	21	8,500
Baptists:			
Regular, North	7,415	9,374	973,820
Regular, South	12,058	18,963	1,608,413
Regular, Colored	14,351	15,654	1,864,600
Six Principle	14	18	937
Seventh-Day	119	115	8,991
Freewill	1,619	1,486	85,109
Original Freewill	118	167	11,864
General	450	550	28,000
Separate	113	103	6,479
United	25	204	13,209
Baptists—Continued.			
Church of Christ	80	152	8,254
Primitive	2,040	3,222	121,347
Old Two Seed in the Spirit Predestinarian	300	473	12,851
Brethren (River):			
Brethren in Christ	152	78	4,000
Old Order, or Yorker	7	8	214
United Zion's Children	20	25	525
Brethren (Plymouth):			
Brethren (I.)	....	109	2,289
Brethren (II.)	....	88	2419
Brethren (III.)	....	86	1,235
Brethren (IV.)	....	31	718
Catholics:			
Roman Catholics	11,636	12,062	8,610,226
Polish Branch	19	18	15,000
Old Catholic	6	5	10,000
Reformed Catholics	6	6	1,500
Catholic Apostolic	95	10	1,394
Chinese Temples	....	47	....
Christadelphians	....	63	1,277
Christians	1,248	1,520	112,835
Christian Catholic (Dowie)	55	50	40,000
Christian Missionary Association	10	13	754
Christian Scientists	12,000	600	1,000,000
Christian Union	183	294	18,214
Church of God (Winnebrennerian)	460	580	38,000
Church Triumphant (Schweinfurth)	....	12	384
Church of the New Jerusalem (Swedenborgians)	143	173	7,679
Communistic Societies:			
Shakers	....	15	1,728
Amana	....	7	1,600
Harmony	....	1	250
Separatists	....	1	200
Altruists	....	1	25
Church Triumphant (Koreshan Ecclesia)	....	5	205
Adonai Shomo	....	1	20
New Icaria	....	1	21
Congregationalist:	5,614	5,604	629,874
Disciples of Christ	6,528	10,528	1,149,982
Dunkards:			
German Baptists (Conservatives)	2,612	850	95,000
German Baptists (Old Order)	150	100	3,500
German Baptists (Progressive)	231	173	12,787
Seventh-Day Baptists (German)	5	6	194
Episcopalians:			
Protestant Episcopal	4,961	6,686	716,431
Reformed Episcopal	103	104	9,743

Denominations.	Churches.	Ministers.	Communicants.
Evangelical Bodies:			
Evangelical Ass'n...	1,052	1,806	118,865
United Evangelical Church	478	985	60,993
Friends:			
Friends (Orthodox).	1,279	820	91,868
Friends (Hicksite)...	115	201	21,992
Friends (Wilburite).	38	52	4,329
Friends (Primitive).	11	9	232
Friends of the Temple	4	4	340
German Evangelical Protestants	44	52	36,156
German Evangelical Synod	909	1,129	203,574
Greek Church:			
Greek Orthodox.....	4	4	20,000
Russian Orthodox....	41	58	45,000
Jews	201	570	1,058,135
Latter-Day Saints (Mormons).			
Church of Jesus Christ of Latter-Day Saints........	1,700	796	300,000
Reorganized Church of Jesus Christ of Latter-Day Saints (Seced'g M'rm'ns).	2,200	600	45,500
Lutherans:			
(General Bodies):			
General Synod....	1,226	1,568	194,442
United Synod in the South	215	390	38,639
General Council...	1,156	2,019	370,409
Synod cal C'nf'r'ce.	2,029	2,650	581,029
(Independent Synods):			
United Norwegian.	354	1,083	126,872
Joint Syn'd of Ohio	457	604	77,362
Buffalo	25	39	4,600
Hauge's, Norweg'n.	97	205	11,483
Texas	11	14	1,700
German of Iowa...	402	824	74,058
Norweg'n Lutheran	272	725	67,208
Michigan	56	86	7,860
Danish in America	47	66	10,000
Icelandic	8	26	3,350
Immanuel	45	50	6,118
Suomai, Finnish ..	11	50	5,925
Norwegian Free...	125	375	37,500
Danish United.....	84	151	8,506
Independent Congregations	85	200	25,000
Waldenstromians	140	150	20,000
Mennonites:			
Mennonite	418	228	22,443
Bruederhoef	9	5	352
Amish	365	124	13,051
Old Amish	71	22	2,038
Apostolic	2	2	209
Reformed	43	34	1,680
General Conference .	138	79	10,395
Church of God in Christ	18	18	471
Old (Wisler)	17	15	610

Denominations.	Churches.	Ministers.	Communicants.
Mennonites—Continued.			
Bundes Conference ..	41	16	3,050
Defenceless	20	11	1,176
Brethren in Christ ..	45	82	2,953
Methodists:			
Methodist Episcopal.	17,521	26,021	2,716,437
Union American M. E.	63	61	2,675
African Methodist Episcopal	5,659	5,775	673,504
African Union Meth. Protestant	80	70	2,000
African Methodist Episcopal Zion	3,155	2,906	536,271
Methodist Protestant	1,647	2,400	181,216
Wesleyan Methodist .	587	506	17,201
Methodist Episcopal, South	6,041	14,244	1,457,864
Congregational Methodist	210	240	20,000
Congregational Meth. (Colored)	5	5	319
New Congregational Methodist	20	17	1,059
Zion Union Apostolic.	30	27	2,346
Colored Methodist	2,187	1,300	199,206
Primitive Methodist.	65	92	6,470
Free Methodist	944	1,123	28,588
Independent Methodist	8	14	2,569
Evangelist Missionary	87	13	4,600
Moravians	118	111	14,817
Presbyterians:			
Presbyterian in U. S. of A. (North	7,335	7,469	973,433
Cumberland Presbyterian	1,734	2,957	180,192
Cumberland Presbyterian Colored .	400	150	39,000
Welsh Calvinistic .	105	185	12,000
United Presbyterian.	918	911	115,901
Presbyterian in U. S. of A. (South).....	1,461	2,959	225,890
Associate Ch. of North America ...	12	31	1,053
Associate Ref Synod of the South	104	131	11,344
Reform Pres. in the U. S. (Synod).....	124	113	9,790
Reform Pres. in N. A. Gen. Synod)..	33	36	5,000
Reform Presb. (Covenanter)	1	1	40
Reform Presb. in U. S. & Canada......	1	1	608
Reformed:			
Reformed in America (Dutch)	698	619	107,594
Reformed in U. S. (German)	1,082	1,660	243,545
Christian Reformed..	96	145	18,096

	Feet.
Bridal Veil, Yosemite	900
Lauterbaum, Switzerland	900
Falls of Terni, near Rome	300
Montmorency Falls, Quebec	250
Fryer's Falls, Scotland	200
Niagara Falls, North America	164
Lidford Cascade, England	100

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Church of Abyssinia	3,000,000
Armenian Church	1,690,000
Coptic Church	120,000
Nestorians	80,000
Jacobites	70,000
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Seventh-Day	119	115	8,991
Freewill	1,619	1,486	85,109
Original Freewill	118	167	11,864
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Church of the New Jerusalem (Swedenborgians)	143	173	7,67
Communistic Societies:			
Shakers	....	15	1,7
Amana	....	7	1,6
Harmony	....	1	2
Separatists	....	1	2
Altruists	....	1	
Church Triumphant (Koreshan Ecclesia)	....	5	
Adonai Shomo	....	1	
New Icaria	....	1	
Congregationalist:	5,614	5,604	629
Disciples of Christ	6,528	10,528	1,149
Dunkards:			
German Baptists (Conservatives)	2,612	850	9
German Baptists (Old Order)	150	100	
German Baptists (Progressi	231		
Seventh-Day (Germ			
Episcopa			
Protest			
Refor			

Denominations.	Churches.	Ministers.	Communicants.
Evangelical Bodies:			
Evangelical Ass'n...	1,052	1,806	118,865
United Evangelical Church	478	985	60,993
Friends:			
Friends (Orthodox).	1,279	820	91,868
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Greek Church:			
Greek Orthodox.....	4	4	20,000
Russian Orthodox....	41	58	45,000
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Texas	11	14	1,700
German of Iowa...	402	824	74,058
Norweg'n Lutheran	272	[illegible]	67,208
Michigan	56	[illegible]	[illegible]
Danish in America	47	[illegible]	[illegible]
Icelandic	8	[illegible]	[illegible]
Immanuel	[illegible]	[illegible]	[illegible]
Suomai, Finnish ..	[illegible]	[illegible]	[illegible]
Norwegian Free...	[illegible]	[illegible]	[illegible]
Danish United...	[illegible]	[illegible]	[illegible]
Independent Congregations	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]

Denominations.	Churches.	Ministers.	Communicants.
Mennonites Continued.			
Bundes Conference ..	41	16	3,050
Defenceless	20	11	1,176
Brethren in Christ ..	45	82	2,053
Methodists:			
Methodist Episcopal.	17,521	26,021	2,716,437
Union American M. E.	63	61	2,675
African Methodist Episcopal	5,650	5,775	673,504
African Union Meth. Protestant	80	70	2,000
African Methodist Episcopal Zion ...	3,155	2,906	536,271
Methodist Protestant	1,647	2,400	181,216
Wesleyan Methodist .	587	506	17,201
Methodist Episcopal, South	6,011	14,244	1,457,864
Congregational Methodist	210	240	20,000
Congregational Meth. (Colored)	5	5	319
New Congregational Methodist	20	17	1,059
Zion Union Apostolic.	30	27	2,346
Colored Methodist ...	2,187	1,300	199,206
Primitive Methodist.	66	92	6,470
Free Methodist	944	1,123	28,588
Independent Methodist	8	14	2,569
Evangelist Missionary	87	13	4,000
Moravians	118	111	14,817
Presbyterians:			
Presbyterian in U. S. of A. (North).....	7,335	7,460	973,433
Cumberland Presbyterian	1,734	2,967	180,192
Cumberland Presbyterian (Colored)...	400	150	39,000
Welsh Calvinistic ...	105	186	12,000
United Presbyterian.	918	911	115,901
[illegible] in U. S. [illegible]th).....	1,461	2,959	225,890
[illegible] Ch. of [illegible]erica	13	31	1,058
[illegible]	[illegible]	181	11,344
[illegible]	[illegible]	12	9,790
[illegible]	[illegible]	10	5,000
[illegible]	[illegible]	1	40
[illegible]	[illegible]	1	608
[illegible]	[illegible]	[illegible]	[illegible]

Denominations.	Churches.	Ministers.	Communicants.
Reformed—Continued.			
Salvation Army	2,689	753	40,000
Schwenkfeldians	3	4	306
Social Brethren	17	20	918
Society for Ethical Culture	.....	4	1,064
Spiritualists	.....	334	45,030
Theosophical Society	.....	40	695
United Brethren			
United Brethren in Christ	1,897	4,229	243,841
United Brethren (Old Constitution)	670	817	226,643
Unitarians	550	459	71,000
Universalists	735	764	48,426
Volunteers of America	500	200	....
Independent Congregations	54	156	14,126

LARGEST CITIES OF THE EARTH

POPULATION ACCORDING TO THE LATEST OFFICIAL CENSUSES.

Cities.	Census Year.	Population.
London	1901	4,536,063
New York	1900	3,437,202
Paris	1896	2,536,834
Berlin	1900	1,884,151
Chicago	1900	1,698,575
Vienna	1901	1,635,647
Canton	est.	1,600,000
Tokio, Japan	1898	1,440,121
Philadelphia	1900	1,293,697
St. Petersburg	1897	1,267,023
Constantinople	est.	1,125,000
Calcutta	1901	1,121,664
Peking	est.	1,000,000
Moscow	1897	988,614
Osaka	1898	821,235
Bombay	1901	770,843
Glasgow	1901	760,423
Hamburg	1900	705,738
Liverpool	1901	685,276
Buenos Ayres	1895	663,854
Warsaw	1897	638,209
St. Louis	1900	575,238
Brussels	1899	570,844
Cairo, Egypt	1897	570,062
Boston	1900	560,892
Naples	1899	544,057
Manchester, England	1901	543,969
Amsterdam	1899	523,557
Rio de Janeiro	1890	522,651
Birmingham, England	1901	522,182
Rome	1899	512,423
Madrid	1897	512,150
Barcelona	1897	509,589
Madras	1901	509,397
Baltimore	1900	508,957
Buda-Pest	1891	505,763
Munich	1900	499,959
Milan	1899	492,162
Melbourne	1891	490,900
Lyons	1896	466,028
Leipzig	1900	455,089
Haidarabad	1901	446,291
Marseilles	1896	442,239
Leeds	1901	428,953
Breslau	1900	422,738
Odessa	1897	405,041
Mexico City	1900	402,000
Dresden	1900	395,349
Sydney	1891	383,390
Cleveland	1900	381,768
Sheffield	1901	380,717
Shanghai	est.	380,000
Dublin	1901	373,179
Cologne	1900	372,229
Turin	1899	359,295
Kioto	1898	353,139
Buffalo	1900	352,387
Belfast	1901	348,965
San Francisco	1900	342,782
Bristol England	1901	328,842
Cincinnati	1900	325,902
Pittsburgh	1900	321,626
Santiago, Chile	1895	320,628
Rotterdam	1899	319,866
Alexandria	1897	319,766
Edinburgh	1901	316,479
Lodz	1897	315,209
Copenhagen	1890	312,859
Stockholm	1899	302,462
Lisbon	1890	301,206
Palermo	1899	292,799
Frankfort-on-Main	1900	288,489
New Orleans	1900	287,104
Detroit	1900	285,704
Milwaukee	1900	285,315
Bucharest	1899	282,071
Antwerp	1899	282,018
Bradford	1901	279,809
Washington	1900	278,718
West Ham, England	1901	267,308
Montreal	1901	266,826
Montevideo	est.	266,000
Lucknow	1901	263,951
Nuremberg	1900	261,022
Bordeaux	1896	256,906
Riga	1897	256,197
Bangkok	est.	250,000
Teheran	est.	250,000
Kiev	1897	247,4[illegible]
Newark	1900	24[illegible]
Manila	1901	[illegible]
Nagoya	1898	
Hull	1901	
Nottingham	1901	
Genoa	1899	
Havana	18[illegible]	
Hanover	1[illegible]	
Rangoon	1[illegible]	

Cities.	Census Year.	Population.
Magdeburg	1900	229,663
Kristiania	1900	225,686
Hong Kong	1891	221,441
Salford	1901	220,956
Lille	1896	216,276
Florence	1899	216,051
Kobe, Japan	1898	215,780
Newcastle	1901	214,803
Dusseldorf	1900	213,767
Leicester	1901	211,574
Stettin	1900	210,680
Delhi	1901	208,385
Toronto	1901	207,971
Chemnitz	1900	206,584
Jersey City	1900	206,433
The Hague	1899	205,328
Valencia	1897	204,768
Louisville	1900	204,737
Benares	1901	203,095
Minneapolis	1900	202,718
Smyrna	est.	201,000
Seoul, Korea	est.	201,000
Cawnpore	1901	197,000
Yokohama	1898	193,762
Charlottenburg, Prussia	1900	189,290
Portsmouth, England	1901	189,160
Agra	1901	188,300
Konigsberg	1900	187,897
Prague	1891	184,109
Mandelay	1901	182,498
Tabriz	1881	180,000
Stuttgart	1900	176,318
Allahabad	1901	175,748
Providence	1900	175,597
Kharkov	1897	174,846
Bahia	1890	174,412
Liege	1899	171,031
Indianapolis	1900	169,164
Bolton	1901	168,205
Cardiff	1901	164,420
Kansas City, Mo	1900	163,752
Bremen	1900	163,418
St. Paul	1900	163,065
Ghent	1899	163,030
Rochester	1900	162,608
Amritsar	1901	162,548
Altona, Germany	1900	161,507
Dundee	1901	160,871
Vilna	1897	159,568
Jaipur	1901	159,550
Bangalore	1901	159,030
Bologna	1899	158,975
Trieste	1891	158,344
Howrah	1901	157,847
Venice	1899	157,785
Elberfeld	1900	156,987
Halle-on-Salle	1900	156,611
Messina	1899	156,552
Tunis	est.	153,000
Strasburg	1900	150,268
Zurich.	1900	150,239
Toulouse	1896	149,963
Adelaide	1899	148,644
Ahmadabad	1891	148,412
Sunderland	1901	146,565
Seville	1897	146,205
Bagdad	est.	145,000
Aberdeen	1901	143,722
Valparaiso	1900	143,022
Dortmund	1900	142,418
Barmen	1900	141,947
Dantzig	1900	140,539
Damascus	est.	140,500
Manheim	1900	140,384
Fez, Morocco	est.	140,000
Oporto	1890	138,860
Oldham, England	1901	137,238
Saratov	1897	137,109
St. Etienne	1896	136,030
Aachen	1900	135,235
Patna	1901	135,172
Catania	1899	134,680
Croydon, England	1901	133,875
Denver	1900	133,859
Toledo	1900	131,822
Kazan	1897	131,508
Allegheny	1900	129,896
Lemberg	1891	128,419
Brunswick	1900	128,177
Colombo, Ceylon	1891	127,836
Blackburn	1901	127,527
Aleppo	est.	127,150
Goteborg	1899	126,849
Malaga	1897	125,579
Columbus	1900	125,560
Roubaix	1896	124,661
Nagpur	1901	124,599
Nantes	1896	123,902
Brighton	1901	123,478
Srinagar	1901	122,536
Hiroshima	1898	122,306
Yekaterinoslav	1897	121,216
Lahore	1901	120,058
Bogota	1886	120,000
Rostov-on-Don	1897	119,889
Havre	1896	119,470
Essen, Germany	1900	118,863
Beirut	est.	118,800
Worcester	1900	118,421
Surat	1901	118,364
Bareilly	1901	117,433
Posen	1900	117,014
Meerut	1901	116,642
Karachi	1901	115,407
Willesden	1901	114,815
Rhondda	1901	113,735
Gratz	1891	113,540
Rouen	1896	113,219
Astrakhan	1897	113,001
Preston	1901	112,982
Basle	1900	112,842
Norwich	1901	111,728
Pernambuco	1890	111,556
Athens	1896	111,486
Poona	1901	111,385
Birkenhead	1901	110,926
Tula	1897	110,048
Gateshead	1901	109,887
Kishinev	1897	108,796
Murcia, Spain	1897	108,408
Syracuse	1900	108,374
New Haven	1900	108,027

Cities.	Census Year.	Population.
Rheims	1896	107,963
Kiel, Germany	1900	107,938
Plymouth	1901	107,509
Nagasaki	1898	107,422
Krefeld	1900	106,928
Kassel, Germany	1900	106,001
Derby	1901	105,785
Leghorn	1899	105,767
Madura	1901	105,501
Paterson, N. J.	1900	105,171
Salonica	est.	105,000

THE WORLD'S HIGHEST MOUNTAINS

Name and Country.	Ft. High.	Miles
Mount Everest (Himalayas), Tibet.	29,002	5¾
Aconcagua, the highest in America, Chile	22,422	4
Sorato, Bolivia	21,284	4
Illimani, Bolivia	21,145	4
Chimborazo, Ecuador	21,422	4⅗
Hindoo-Koosh, Afghanistan	20,600	3¾
Mount McKinley, highest in North America, Alaska	20,464	3¾
Demavend, highest of Elburz Mountains, Persia	20,000	3¾
Cotopaxi, highest volcano in the world, Ecuador	19,496	3¾
Antisana, Ecuador	19,150	3½
St. Elias, Alaska	17,850	3⅛
Popocatapetl, volcano, Mexico	17,540	3⅛
Mauna Loa, highest in Oceanica, Hawaii	16,000	3
Mount Brown, highest peak of Rocky Mountains, British America	15,900	3
Mont Blanc, highest in Europe, Alps, France	15,732	3
Mont Rosa, next highest peak of Alps, Italy	15,150	2⅞
Limit of perpetual snow at the equator	15,207	2⅞
Pichincha, Ecuador	15,924	3
Mount Whitney, California	14,887	2¾
Mount Fairweather, Alaska	14,500	2¾
Mount Shasta, California	14,442	2¾
Mount Ranier, Washington	14,444	2¾
Long's Peak, Rocky Mountains, Colorado	14,271	2⅝
Mount Ararat, Armenia	14,320	2⅛
Pike's Peak, Colorado	14,216	2⅛
Mount Ophir, Sumatra	13,800	2⅝
Fremont's Peak, Rocky Mountains, Wyoming	13,570	2⅝
Mount St. Helens, Washington	13,400	2½
Peak of Teneriffe, Canaries	12,182	2⅛
Miltzin, highest of Atlas Mountains, Morocco	11,500	2
Mount Hood, Oregon	11,500	2
Mount Lebanon, Syria	10,533	2
Mont Perda, highest of Pyrenees, France	10,950	2
Mount Etna, volcano, Sicily	10,835	2
Monte Corno, highest of Apennines, Naples	9,523	1¾
Sneehattan, highest Dovrefield Mountains, Norway	8,115	1½
Pindus, highest in Greece	7,677	1½
Mount Sinai, Arabia	6,541	1¼
Mitchell Mountain, highest in North Carolina	7,350	1½
Mount Washington, highest White Mountains, N. Hampshire	6,285	1¼
Mount Marcy, highest in New York.	5,402	1
Mount Hecla, volcano, Iceland	5,104	1
Ben Nevis, highest in Great Britain, Scotland	4,406	⅞
Mansfield, highest of Green Mountains, Vermont	4,280	¾
Peaks of Otter, Virginia	4,260	¾
Mount Vesuvius, Naples	4,253	¾
Round Top, highest of Catskill Mountains, New York	3,804	¾

HEIGHTS OF THE TALLEST MONUMENTS, TOWERS AND STEEPLES IN THE WORLD

	Feet.
Paris, Eiffel Tower	989
Washington, Washington Monument	555
Egypt, Pyramid of Cheops	486
Belgium, Antwerp Cathedral	476
France, Strasburg Cathedral	474
Egypt, Pyramid of Cephrenes	456
Rome, St. Peter's Church	448
Germany, St. Martin's Church at Landshut.	411
England, St. Paul's Church, London	365
England, Salisbury Cathedral	400
Italy, Cathedral at Florence	386

LENGTHS OF THE WORLD'S PRINCIPAL RIVERS

NORTH AMERICA.

Rivers.	Miles.
Missouri to the Gulf (forming the longest river in the world)	4,200
Missouri (to its junction with the Mississippi)	2,900
Mississippi proper	3,200
Mackenzie	2,300
St. Lawrence	2,000
Arkansas	2,000
Saskatchewan and Nelson	1,900
Yukon	1,600
Rio Grande	1,500
Nebraska	1,200
Red River	1,200
Columbia	1,400
Colorado	2,000

NORTH AMERICA—Continued.

Rivers	Miles.
Yellowstone	1,000
Ohio	950
Kansas	900
Tennessee	800
Fraser	750
Red River of the North	700
Brazos	650
Wisconsin	600
Cumberland	600
Alabama	600
Wabash	550
Appalachicola	550
Susquehanna	500
Potomac	500
James	500
Roanoke	500
Savannah	500
St. John	450
Connecticut	450
Great Pedee	450
Altamaha	400
Sacramento	400
Penobscot	350
Hudson	350
Cape Fear	350
Pearl	350
Nueces	350
Sabine	350
Severn	300
Kennebec	300
Delaware	300

SOUTH AMERICA.

Amazon	3,750
Rio de la Plata	2,300
Madeira	2,000
Orinoco	1,550
San Francisco	1,550
Tocantins	1,100
Colorado	1,000
Rio Negro	1,000
Magdalena	900
Parnaiba	900

EUROPE.

Volga	2,000
Don	1,300
Danube	1,800
Dnieper	1,080
Rhine	880
Dvina	700
Petchora	737
Elbe	737
Vistula	691
Loire	600
Tagus	550
Dneister	500
Guadiana	500
Seine	498
Douro	450
Oder	450
Rhone	450
Po	450
Mezene	400
Desna	400
Guadalquiver	400

EUROPE—Continued.

Rivers	Miles.
Duna	350
Niemen	350
Ebro	350
Dahl	300
Bug	300
Weser	300
Garonne	300
Thames	215

ASIA.

Yenesei	3,400
Yang-tse-Kiang	3,320
Ob	3,000
Hoang-Ho	2,800
Lena	2,700
Amur	2,650
Brahmaputra	2,300
Cambodia	2,000
Indus	1,850
Euphrates	1,750
Ganges	1,600

AFRICA.

Nile	4,100
Niger	3,000
Congo	2,900
Zambesi	1,800
Orange	1,000
Limpopo	900
Senegal	800

AUSTRALIA.

Murray	1,300
Darling	1,200

AREA AND DEPTH OF OCEANS

Area of oceans and inland seas connected with them 142,132,980 square miles, or 72 per cent of total surface of the earth.

Area of Arctic ocean estimated at 4,632,000 square miles. Atlantic ocean, 34,301,400 square miles; greatest depth "International Deep," off St. Thomas Island, West Indies, 27,366 feet. Indian ocean, 28,615,600 square miles. Pacific ocean, 67,699,630 square miles, and 9,000 by [illegible]000 miles in greatest extent, comprises nearly one-half the total water area; greatest depth sounded, "Tuscarora Deep," north of Japan, 27,930 feet. Area of Antarctic ocean estimated at 6,040,000 square miles, depth 4,920 feet. Supposed depth of 83 per cent of total ocean area more than 6,000 feet.

RACES OF MANKIND

The following is compiled from the arrangement by the Ethnologist Figuier and others:

WHITE RACE.

European Branch.	Teutonic Family	Scandinavians, Germans, English.
	Latin Family	French, Spaniards, Italians, Moldo-Wallachians.
	Slavonian Family	Russians, Finns, Bulgarians, Servians, Magyars, Croats, Tchecks, Poles, Lithuanians.
	Greek Family	Greeks, Albanians.
Aramean Branch.	Libyan Family	Egyptians, Berbers.
	Semitic Family	Arabs, Jews, Syrians.
	Persian Family	Persians, Afghans, Kurds, Armenians, Ossetines.
	Georgian Family	Georgians.
	Circassian Family	Circassians, Mingrelians.

YELLOW RACE.

Hyperborean Branch.	Lapp Family	Samoyede, Kamtschadale, Eskimo, Tenissian, Jukaghirite, and Koriak Families.
Mongolian Branch.	Mongol Family	Mongols, Kalmucks, Buriats.
	Tungus Family	Tunguses, Manchus.
	Turk Family	Turkomans, Kirghis, Nogays, Osmanlis.
	Yakut Family	Yakuts.
Sinaic Branch.	Chinese Family	Chinese.
	Japanese Family	Japanese.
	Indo-Chinese Family	Burmese, Siamese.

BROWN RACE.

Hindoo Branch.	Hindu Family	Sikhs, Jats, Rajpoots, Mahrattas, Bengalese, Cingalese.
	Malabar Family	Malabars, Tamals, Telingas.
Ethiopian Branch.	Abyssinian Family	Abyssinians, Berabras, Gallas.
	Fellan Family	Fellans.
Malay Branch.	Malay Family	Malays, Javanese, Battas, Bougis, Maccassars, Dyaks, Tagals.
	Polynesian Family	Maoris, Tongas, Tahitians, Pomotouans, Marquesans, Hawaiians.
	Micronesian Family	Ladrone, Caroline, and Mulgrave Islanders.

RED RACE.

Southern Branch.	Andian Family	Quichuas (or Incas), Antis, Andians, Araucanians.
	Pampean Family	Patagonians, Puelches, Charruas, Tobas, Moxas, Abipous, etc.
	Guarani Family	Guaranis, Bocotudos.
Northern Branch.	Southern Family	Aztecs, Mayas, Lencas, Othomis, Tarascas, etc.
	Northeastern Family	Cherokees, Hurons, Iroquois, Sioux, Apaches, Comanches, Creeks, etc.
	Northwestern Family	Chinooks, Digger Indians, Nootkans, etc.

BLACK RACE.

Western Branch.	Kaffir Family	
	Hottentot Family	
	Negro Family	
Eastern Branch	Papuan Family	Fijians, New Caledonians, etc.
	Andaman Family	Andamans, Australians.

GAZETTEER OF THE WORLD

COMPRISING ALL THE GEOGRAPHICAL AND POLITICAL DIVISIONS OF THE EARTH; THEIR NAMES, AREAS, AND POPULATIONS

Based Upon the Latest Census Reports and Official Estimates

In the following pages no attempt has been made to present all the matter usually included in gazetteers; rivers, lakes, mountains, et cetera, do not change, and as such subjects are given in so many books, they have been omitted from these pages to make room for subjects about which recent information is difficult to obtain.

In brief, this Gazetteer gives all the geographical and political divisions of the world; the principal subdivisions, as provinces, states, territories, counties; all cities of 25,000 or more inhabitants (with a few exceptions where reliable information has not been obtainable); the states, territories, and possessions of the United States, and under each all incorporated cities and towns of 1,000 or more inhabitants, as returned by the census of 1900.

The following signs and abbreviations have been used:

*	*the capital of a state or nation*	**Eng.**	*England, English*	**p. or pop.**	*population*
□	*square miles*	**Fr.**	*French*	**pen.**	*peninsula*
Am.	*America*	**Ger.**	*German*	**posses.**	*possession*
cen.	*central*	**inc.**	*including*	**prov.**	*province*
co.	*county*	**ind.**	*independent*	**Rus.**	*Russian*
dep.	*dependency*	**isl.**	*island*	**So.**	*South, Southern*
E.	*East, Eastern*	**mts.**	*mountains*	**ter.**	*territory*
		No.	*North, Northern*	**W.**	*West, Western*

A

Aachen, city, Prussia, p. 135,235.
Aarhus, city, Denmark, p. 33,308.
Aberdeen', city, Scotland, p. 153,108.
Abyssin'ia, ind. state, E. Africa, □ 150,000, p. 3,500,000.
Adan'a, city, Asia Minor, p. 45,000.
Adelaide, * South Australia, p. 148,644.
Aden, volcanic pen. on Arabian coast (British), □ 75, p. 41,910.
Adrianople, city, Turkey, p. 81,000.
Afghanistan', cen. Asia, □ 215,400, p. 2,360,000, * Kabul.
Africa, continent, □ 11,518,104, p. 170,000,000.
Agra, city, India, p. 188,300.
A'guas Calien'tes, state, Mexico, □ 2,950, p. 102,378.—Its * p. 35,052.
Aix-la-Chapelle', French name for Aachen, above.
Ajmere', city, India, p. 75,759.
Ajmer'-Marwa'ra, prov. India, □ 2,711, p. 476,330.
Akron, Ohio, p. 42,728.
Alabama, So. cen. state, □ 52,250, p. 1,828,697, * Montgomery.
Incorporated cities and towns of 1,000 pop. or more in 1900:

Alabama City	2,276	Avondale	3,060
Alexander	1,061	Bessemer	6,358
Anniston	9,695	Birmingham	38,415
Athens	1,010	Brewton	1,382
Attalla	1,692	Bridgeport	1,247
Auburn	1,447	Columbia	1,182

Alabama.—Continued.

Columbiana	1,075	Montgomery	30,346
Cullman	1,255	New Decatur	4,437
Dadeville	1,136	Opelika	4,245
Decatur	3,114	Oxanna	1,184
Demopolis	2,606	Oxford	1,372
Dothan	3,275	Ozark	1,570
Ensley	2,100	Phoenix	4,163
Eufaula	4,532	Piedmont	1,745
Evergreen	1,277	Pratt City	3,485
Florence	6,478	Prattville	1,929
Fort Deposit	1,078	Roanoke	1,155
Fort Payne	1,037	Russellville	1,602
Gadsden	4,282	Scottsboro	1,014
Geneva	1,032	Selma	8,713
Girard	3,840	Sheffield	3,333
Greensboro	2,416	Talladega	5,056
Greenville	3,162	Troy	4,097
Huntsville	8,068	Tuscaloosa	5,094
Jackson	1,039	Tuscumbia	2,348
Jacksonville	1,176	Tuskegee	2,170
Jasper	1,661	Union Springs	2,634
Lafayette	1,629	Uniontown	1,047
Lanett	2,909	Warrior	1,018
Marion	1,698	Wilsonville	1,095
Mobile	38,469	Woodlawn	2,848

Alaska, ter. of U. S., □ 590,884, p. 63,592, * Sitka.
Cities and towns of more than 1,000 pop. in 1900:

Juneau	1,864	Sitka	1,396
Nome	12,488	Skagway	3,117

Albany, * N. Y., p. 94,151.
Alberta, ter. Canada, □ 100,000.

Alcoy, city, Spain, p. 31,099.
Aleppo, city, Syria, p. 127,150.
Alessandria, city, Italy, p. 79,015.
Alexandria, city, Egypt, p. 319,766.
Algeria, Fr. posses. in No. Africa, □ 184,474, p. 4,430,000, * Algiers, p. 96,784.
Alicante, city, Spain, p. 49,463.
Aligarh, city, India, p. 70,127.
Allahabad, city, India, p. 175,748.
Allegheny, Pa., p. 129,896.
Allentown, Pa., p. 35,416.
Almeria, city, Spain, p. 46,806.
Alost, city, Belgium, p. 29,746.
Alsace-Lorraine, Ger. imperial ter., □ 5,600, p. 1,717,451, * Strassburg, p. 135,608.
Altenburg, * Saxe-Altenburg, Germany, p. 33.621.
Altona, city, Prussia, p. 161,507.
Altoona, Pa., p. 38,973.
Alwar, city, India, p. 56,740.
America, North, continent, □ 7,952.386, p. 97,500,000—**South**, continent, □ 6,844,602, p. 40,500,000.
A'miens, city, France, p. 88,731.
Amoy, city on Haimun Isl., China, p. 96,000.
Amrit'sar, city, India, p. 162,548.
Amsterdam, city, Holland, p. 523,557.
Anam' (or Annam), Fr. posses. in Asia, So. of China, □ 88,780, p. 5,000,000, * Hue, p. 30,000.
Anatolia, see Asia Minor.
Anco'na, city, Italy, p. 60,428.
Andaman' Islands (over 200), Bay of Bengal (British), □ 2,000, p. 29,000, * Port Blair, p. 15,000.
Andijan', city, Rus. Turkestan, p. 46,680.
Andorra, republic in Pyrenees mts. between France and Spain, □ 175, p. 6,000.
Angers, city, France, p. 77,164.
An'glesey, co. Wales, □ 275, p. 50,590.
Angola (Portuguese W. Africa), □ 484,800, p. 4,119,000, * St. Paul de Loanda.
Angouleme, city, France, p. 38,068.
An'halt, Ger. duchy, □ 906, p. 316,027, * Dessau, p. 42,375.
Antana'narivo', * Madagascar, p. 260,000.
Antwerp, city, Belgium, p. 282,018.
Arabia, pen. So. W. Asia, □ 1,200,000 (est.), p. (est.) 5,000,000.
Ar'ad, city, Hungary, p. 53,800.
Arequi'pa, city, Peru, p. 35,000.
Arezzo, city, Italy, p. 45,854.
Ar'gentine Republic, So. Am., □ 1,113,849, p. 4,094,911, * Buenos Ayres.
Arizona, ter. W. part U. S., □ 113,020, p. 122,931, * Phoenix.
Incorporated cities and towns of 1,000 pop. or more in 1900:

Flagstaff	1,271	Prescott	3,559
Globe	1,495	Tucson	7,531
Jerome	2,861	Winslow	1,305
Nogales	1,761	Yuma	1,519
Phoenix	5,544		

Arkansas, So. cen. state, □ 53,850, p. 1,311,564, * Little Rock.
Incorporated cities and towns of 1,000 pop. or more in 1900:

Arkadelphia	2,739	Fort Smith	11,587
Arkansas City	1,091	Gurdon	1,045
Augusta	1,040	Hamburg	1,260
Batesville	2,327	Harrison	1,551
Benton	1,025	Helena	5,550
Bentonville	1,843	Hope	1,644
Black Rock	1,400	Hot Springs	9,973
Brinkley	1,648	Huntingdon	1,298
Camden	2,840	Jonesboro	4,508
Clarendon	1,840	Junction City	1,251
Clarksville	1,086	Little Rock	38,307
Coal Hill	1,341	Magnolia	1,614
Conway	2,003	Malvern	1,582
Corning	1,041	Marianna	1,707
Dardanelle	1,602	Mena	3,423
De Queen	1,204	Monticello	1,597
Eldorado	1,069	Morrillton	1,707
Eureka Spgs.	3,572	Newport	2,866
Fayetteville	4,061	Paragould	3,324
Fordyce	1,710	Pine Bluff	11,496
Forrest City	1,361	Prescott	2,005

Arkansas.—Continued.

Rogers	2,153	Stamps	1,021
Russellville	1,832	Stuttgart	1,258
Searcy	1,995	Texarkana	4,914
Siloam Sp'ngs	1,748	Van Buren	2,573
Springdale	1,251	Wynne	1,629

Armenia, country, W. Asia, belonging to Turkey, Persia and Russia; Turkish Armenia and Khurdistan form a province; □ 72,491, p. 2,472,400.
Arnhem, city, Holland, p. 57,248.
Ascension, isl. So. Atlantic (British), □ 35, p. 430.
Ascoli Piceno, city, Italy, p. 31,499.
Asia, largest continent, □ 17,039,066, p. 850,000,000.
Asia Minor (or Anatolia), part of Turkish Empire, □ 194,389, p. 9,355,000.
Assam', prov. India, □ 49,004, p. 6,122,201.
Assiniboi'a, ter. Canada, □ 90,340.
Assiout, city, Egypt, p. 42,078.
Astrakhan', city, Russia, p. 113,001.
Asuncion, * Paraguay, p. 45,000.
Athabasca, ter. Canada, □ 251,300.
Athens, * Greece, p. 111,486.
Atlanta, * Ga., p. 111,486.
Atlantic City, N. J., p. 27,838.
Auburn, N. Y., p. 30,345.
Auckland, city, New Zealand, p. 31,424.
Augsburg, city, Bavaria, Germany, p. 81,896.
Augusta, Ga., p. 39,441.
Australasia, including Australia and Oceania, □ 3,458,000, p. 5,684,600.
Australia, Commonwealth of, comprises states of New South Wales, Victoria, Queensland, So. Australia, W. Australia and Tasmania; □ 2,972,573, p. 3,777,212, temporary * Melbourne.
Austria, empire, part of Austria-Hungary, □ 115,903, p. 26,107,300, * Vienna.
Austria-Hungary, European dual monarchy (Austrian Empire and the Hungarian Kingdom), □ 240,942, p. 45,310,831.
Avelli'no, city, Italy, p. 28,579.
Avignon, city, France, p. 45,107.
Ayr, city, Scotland, p. 28,624.
Azov', city, Russia, p. 25,488.

B

Baden, Ger. grand-duchy, □ 5,821, p. 1,866,584, * Karlsruhe.
Bagdad, city, Mesopotamia (Turkey), Asia, p. 145,000.
Bahamas, isls. British West Indies, □ 5,450, p. 47,565.
Bahi'a, city, Brazil, p. 174,412.
Bahrein' Islands, Persian Gulf (British), p. 70,000, * Moharek, p. 22,000.
Baireuth (see Bayreuth).
Baku', city, Caucasus, Russia, p. 112,253.
Bale, Fr. name for Basel, Switzerland.
Ballarat', city, Victoria, Australia, p. 46,410.
Baltimore, Md., p. 508,957.
Baluchistan', state dependent on India, So. Cen. Asia, □ 130,000, p. 500,000, * Kalat.
Bamberg, city, Bavaria, Germany, p. 38,940.
Bangalore', city, India, p. 159,030.
Bangkok, * Siam, p. 250,000.
Barbados, isl., Lesser Antilles (British), □ 166, p. 192,000, * Bridgetown.
Barca (or Benghazi), region, No. Africa, E. of Tripoli, ancient Cyrenaica, Turkish prov. * Benghazi, p. 500,000.
Barcelona, city, Spain, p. 509,589.
Bareilly, city, India, p. 117,433.
Barfurush', city, Persia, p. 50,000.
Bari, city, Italy, p. 82,833.
Barmen, city, Prussia, p. 141,947.
Baroda, state, India, □ 8,226, p. 1,950,927. Its * p. 103,782.
Barquisime'to, city, Venezuela, p. 31,476.
Barrow-in-Furness, town, Eng., p. 57,584.
Basel, city, Switzerland, p. 112,253.
Basu'toland, So. Africa, N. E. Cape Colony, British, □ 10,293, p. 250,000, * Maseru, p. 862.
Batavia, * Java, p. 115,567.
Bath, city, Eng., p. 49,817.

Bavaria, Ger., kingdom, □ 29,282, p. 6,175,-153, * Munich.
Bay City, Mich., p. 27,628.
Bayonne', N. J., p. 32,722.
Bayreuth, city, Bavaria, Germany, p. 27,693.
Bechuan'aland Protectorate, So. Africa, N. and W. of Transvaal, British, □ 213,000, p. 200,000, * Palachwe, p. 25,000.
Bedford, co., Eng., □ 466, p. 171,700.
Bei'rut (ba'root), city, Syria, p. 118,800.
Belem, city, Brazil, p. 50,064.
Belfast, city, Ireland, p. 348,965.
Belgium, kingdom, Europe, □ 11,373, p. 6,-744,532, * **Brussels**.
Belgrade, * Servia, p. 59,494.
Bella'ry, city, India, p. 57,700.
Benares, city, India, p. 203,095.
Ben'digo (Sandhurst), city, Victoria, Australia, p. 43,112.
Benevento, city, Italy, p. 26,339.
Bengal States, British India, □ 59,259, p. 3,735,715. **Bengal**, prov., India, □ 151,-543, p. 74,713,020, * Calcutta.
Benghazi (or Barca which see), Turkish prov., No. Africa, □ 54,900, p. 500,000.
Berar', prov., India, □ 17,718, p. 2,752,418.
Berdechev, city, Russia, p. 53,728.
Bergamo, city, Italy, p. 47,206.
Bergen, city, Norway, p. 72,179.
Berks, co., Eng., □ 712, p. 180,366.
Berlin, * German Empire, p. 1,884,151.
Bermudas, islands, No. Atlantic, British, 20, p. 16,423, * Hamilton, p. 1,296.
Bern (or Berne), * Switzerland, p. 63,994.
Besancon, city, France, p. 57,556.
Beziers, city, France, p. 48,868.
Bhagalpur', city, India, p. 75,273.
Bhutan', ind. state of Asia, □ 16,800, p. 35,000, * Punakha.
Bika'nir, city, India, p. 53,071.
Bilbao, city, Spain, p. 74,093.
Binghamton, N. Y., p. 39,647.
Birkenhead, city, Eng., p. 110,926.
Birmingham, Ala., p. 38,415—city, Eng., p. 522,182.
Bismarck Archipelago, islands, N. E. of New Guinea, □ 19,000.
Bitlis, city, Armenia, p. 38,800.
Blackburn, city, Eng., p. 127,527.
Blagovyeshchensk, city, Siberia, p. 32,606.
Blumenau, city, Brazil, p. 40,000.
Bochum, city, Prussia, p. 53,842.
Bogota, * Colombia, p. 120,000.
Bohemia, prov., Austria, □ 20,060, p. 6,318,-280.
Bohol, isl., Philippines, □ 1,300.
Bokhara, Rus. vassal state, Asia, □ 92,000, p. 2,500,000, * Bokhara, p. 75,000.
Bolivia, republic, So. Am., □ 567,430, p. 1,310,000, * Sucre, p. 27,350.
Bologna, city, Italy, p. 158,975.
Bolton, city, Eng., p. 168,205.
Boma, * Congo Free State, on Congo R.
Bombay States, British India, □ 61,457, p. 6,891,691. **Bombay** (presidency), India, □ 125,144, p. 18,584,496, * Bombay, p. 770,-843.
Bootle, town, Eng., p. 58,558.
Bordeaux, city, France, p. 257,500.
Borneo, isl. East Indies, belongs to Dutch and British, □ 243,843, p. 1,355,580.
Bos'nia and **Herzegovi'na**, Turkish provs. under government of Austria-Hungary, □ 23,262, p. 1,568,092, * Sarajevo, p. 38,083.
Boston, * Mass., p. 560,822.
Boulogne, city, France, p. 46,807.
Boulogne-sur-Seine, city, France, p. 37,418.
Bourges, city, France, p. 43,587.
Bournemouth, town, Eng., p. 47,003.
Bradford, city, Eng., p. 279,809.
Braga, city, Portugal, p. 23,089.
Brai'la, city, Rumania, p. 58,392.
Brazil, republic, So. Am., □ 3,218,130, p. 14,333,915, * Rio de Janeiro.
Brecknock, co., Wales, □ 734, p. 54,211.
Bremen, German free town, □ 99, p. 244,697.
Brescia, city, Italy, p. 69,833.
Breslau, city, Prussia, p. 422,738.
Brest, city, France, p. 74,538.
Bridgeport, Conn., p. 70,996.
Brighton, city, Eng., p. 123,478.
Brisbane, * Queensland, Australia, p. 48,738.
Bristol, city, Eng., p. 328,842.
British Columbia, prov. Canada, □ 383,300, p. 190,000, * Victoria.
British Empire, comprises The United Kingdom of Great Britain and Ireland, and India, the Colonies, Protectorates and Dependencies, □ 9,043,577, p. 382,898,200, * London.
British Guiana, So. Am., □ 120,000, p. 278,-328, * Georgetown, p. 53,176.
British Honduras, Crown colony, Cen. Am., □ 7,562, p. 35,226, * Belize, p. 6,972.
British North Borneo, No. part Isl. of Borneo, □ 31,106, p. 175,000, * Sandakan.
British West African Colonies (inc. Gold Coast, Lagos, Gambia, and Sierra Leone which see).
British West Indies, comprise six groups: Bahamas, Barbados, Jamaica with Turks Islands, Leeward Islands, Trinidad with Tobago, and Windward Islands.
Brockton, Mass., p. 40,063.
Bruges, city, Belgium, p. 53,050.
Brunei, ter. on N. W. coast Borneo (British), □ 15,000, p. 45,000.
Brunn, city, Austria, p. 108,944.
Brunswick, Ger. duchy, □ 1,424, p. 464,251, * Brunswick, p. 128,177.
Brussa, city, Asia Minor, p. 76,303.
Brussels, * Belgium, on Senne R., p. (inc. suburbs) 570,844.
Bucharest', * Rumania, p. 282,071.
Buckeburg, * Schaumburg-Lippe, Ger., p. 5,620.
Buckingham, co., England, □ 743, p. 196,844.
Bu'dapest, * Hungary, p. 733,358.
Buenos Ayres, (bway'nos ay'res), * Argentine Rep., on La Plata R., p. 795,323.
Buffalo, N. Y., p. 352,387.
Bukowi'na, prov., Austria, □ 4,035, p. 729,921.
Bulgaria (inc. E. Roumelia), under suzerainty of Turkey, □ 37,860, p. 3,310,713, * Sofia.
Burgos, city, Spain, p. 30,856.
Burma States, British India, □ 62,661, p. 1,228,460.—**Burma**, prov. India, □ 171,430, p. 9,221,161. — **Lower**, * Rangoon. — **Upper**, * Mandalay.
Burnley, city, Eng., p. 97,044.
Burton-upon-Trent, town, Eng., p. 50,386.
Bury, town, Eng., p. 58,028.
Butte, Mont., p. 30,470.
Byelostok, city, Russia, p. 63,927.

C

Cad'iz, city, Spain, p. 70,177.
Caen (kon), city, France, p. 45,380.
Cagl'iari, city, Italy, p. 45,761.
Cairo, (ki-ro), * Egypt, p. 570,062.
Calais, city, France, p. 56,940.
Calcutta, * Bengal and British India, p. (with suburbs), 1,121,664.
Calicut, city, India, p. 75,510.
California, W. state, □ 158,360, p. 1,485,053, * Sacramento.
Incorporated cities and towns of 1,000 pop. or more in 1900:

Alameda	16,464	Hayward	1,965
Anaheim	1,456	Healdsburg	1,869
Auburn	2,050	Hollister	1,315
Bakersfield	4,836	Kern	1,291
Benicia	2,751	Lincoln	1,061
Berkeley	13,214	Livermore	1,493
Chico	2,640	Long Beach	2,252
Colton	1,285	Los Angeles	102,479
Colusa	1,441	Los Gatos	1,915
Corona	1,434	Martinez	1,380
Emeryville	1,016	Marysville	3,497
Eureka	7,327	Merced	1,969
Fort Bragg	1,590	Modesto	2,024
Fresno	12,470	Monrovia	1,205
Gilroy	1,820	Monterey	1,748
Grass Valley	4,719	Napa	4,036
Hanford	2,929	National City	1,086

California.—Continued.

Nevada City...3,250	San L's Obispo 3,021
Oakland 66,960	San Mateo.....1,832
Orange 1,216	San Pedro.....1,787
Pacific Grove..1,411	San Rafael....3,879
Palo Alto......1,658	Santa Ana.....4,933
Pasadena 9,117	Santa Barbara 6,587
Paso Robles...1,224	Santa Clara...3,650
Petaluma 3,871	Santa Cruz....5,659
Placerville 1,748	Santa Monica..3,057
Pleasanton 1,100	Santa Rosa....6,673
Pomona 5,526	Sausalito 1,628
Red Bluff......2,750	Selma 1,083
Redding 2,946	Sonora 1,922
Redlands 4,797	So. Pasadena..1,001
Redwood 1,653	Stockton 17,506
Riverside 7,973	Tulare 2,216
Rocklin 1,050	Ukiah 1,850
Sacramento ..29,282	Vacaville 1,220
St. Helena.....1,582	Vallejo 7,965
Salinas 3,304	Ventura 2,470
San Bern'dino 6,150	Visalia 3,085
San Diego....17,700	Watsonville ..3,528
San F'ncisco 342,782	Whittier 1,590
San Jose......21,500	Woodland 2,886
San Leandro..2,253	Yreka 1,254

Caltanissetta, city, Italy, p. 38,719.
Cambodia, Fr. possess., Indo-China, □ 40,-530, p. 1,500,000, * Pnom-Penh, p. 50,000.
Cambridge, Mass., p. 91,886.—Co. Eng., □ 487, p. 120,634.
Camden, N. J., p. 75,935.
Campeche, state, Mexico, □ 18,087, p. 87,264.
Canada, Dominion of, British No. Am., □ 3,653,946, p. 5,370,000, * Ottawa.
Canary Islands, W. of Morocco, □ 2,808, p. 334,521.
Cane'a, * Crete, p. 21,025.
Canterbury, town, Eng. p. 24,868.
Canton, Ohio, p. 30,667.—city, China, on Pearl R., p. (est.) 2,500,000.
Cape of Good Hope (Cape Colony), So. Africa, British (comprises Colony proper E. & W. Griqualand, Tembuland, Transkei, Walfish Bay and Pondoland), □ 221,311, p. 1,527,224, * Cape Town, p. 51,251 (with suburbs, p. 83,718).
Cape Verde Islands, Atlantic Ocean, belong to Portugal, □ 1,480, p. 114,130.
Cara'cas, * Venezuela, p. 72,429.
Car'diff, city, Wales, p. 164,420.
Cardigan, co., Wales, □ 692, p. 61,076.
Carinthia, prov., Austria, □ 4,005, p. 367,344.
Carmarthen, co., Wales, □ 918, p. 135,326.
Carnarvon, co., Wales, □ 563, p. 125,669.
Carniola, prov., Austria, □ 3,856, p. 508,340.
Caroline Islands, group in N. Pacific, belong to Germany, □ 560.
Carthagena, city, Spain, p. 86,245.
Caserta, city, Italy, p. 35,060.
Castellon, city, Spain, p. 31,272.
Catania, city, Italy, p. 134,680.
Catanzaro, city, Italy, p. 36,251.
Caucasia, So. prov., Russia, □ 180,843, p. 9,248,695.
Cawnpur', city, India, p. 197,000.
Ceara', city, Brazil, p. 40,902.
Cebu, isl., Philippines, □ 2,400.
Cedar Rapids, Iowa, p. 25,656.
Celebes, isl., Dutch E. Indies, □ 71,470, p. 1,997,860.
Central Africa Protectorate, British, □ 42,-217, p. 900,560, * Blantyre, p. 6,100.
Central India States, British India, □ 78,571, p. 8,501,883.
Central Provinces, British India, □ 86,501, p. 9,845,318.—**States**, British India, □ 29,-375, p. 1,983,496.
Cette, city, France, p. 32,729.
Ceylon' isl., S. of India, British colony, □ 25,333, p. 3,477,094, * Colombo.
Charleston, S. C., p. 55,807.
Charlottenburg, city, Prussia, p. 189,290.
Chattanooga, Tenn., p. 30,154.
Chehkiang, prov., China, □ 34,700 p. 11,589,-000.
Chelsea, Mass., p. 34,072.
Chemnitz, *city*, Saxony, p. 206,584.
Cherbourg, city, France, p. 40,783.
Chester, Pa., p. 33,988.—co. Eng., □ 1,009, p. 601,070.—Its * p. 36,281.
Chia'pas, state, Mexico, □ 27,222, p. 318,730.
Chicago, Ill., p. 1,698,575.
Chifu, city, China, on Gulf of Chili, p. 35,000.
Chihuahua, state, Mexico, □ 87,802, p. 260,-008.
Chile, republic, So. Am., □ 290,829, p. 3,110,-085, * Santiago.
Chili (or Pe-chi-li), prov., China, □ 57,800, p. 17,937,000.
Chillan', city, Chile, p. 35,052.
China (Proper), division of Chinese Empire, □ 1,353,350, p. 383,000,000, * Peking.
Chinese Empire, E. Asia, comprising China Proper, and the Dependencies of Manchuria, Mongolia, Tibet, Jungaria and East Turkestan, □ 4,234,910, p. 399,680,000, * Peking.
Chinkiang, city, China, on Yangste R., p. 140,000.
Christiania, * Norway, p. 225,686.
Christmas Island, 200 mi. S. W. of Java, British.
Cienfue'gos, city, Cuba, p. 30,038.
Cincinnati, Ohio, p. 325,902.
Clermont-Ferrand', city, France, p. 50,870.
Cleveland, Ohio, p. 381,768.
Clichy', city, France, p. 33,895.
Coahui'la, state, Mexico, □ 63,569, p. 237,815.
Coast Land, prov., Austria, □ 3,084, p. 755,-183.
Coatbridge, town, Scotland, p. 160,871.
Cochin-China, Fr. posses. S. of Anam, Indo-China, □ 23,160, p. 2,323,499, * Saigon.
Coimbatore', city, India, p. 52,931.
Coli'ma, state, Mexico, □ 2,272, p. 55,264.
Cologne, city, Prussia, p. 372,229.
Colombia, republic, So. Am., □ 505,000, p. 3,878,000, * Bogota.
Colombo, * Ceylon, p. 127,838.
Colorado, W. state, □ 103,925, p. 539,700. * Denver.

Incorporated cities and towns of 1,000 pop. or more in 1900:

Alamosa, ...1,141	Grand Junct'n 3,503
Anaconda 1,059	Greeley 3,023
Aspen 3,303	Gunnison 1,200
Black Hawk...1,200	Idaho Springs.2,502
Boulder 6,150	La Junta......2,513
Buena Vista...1,006	Las Animas...1,192
Canyon City...3,776	Leadville 12,455
Central City...3,114	Longmont 2,201
Colorado City.2,914	Loveland 1,091
Colorado Sp's 21,085	Manitou 1,303
Cripple Cr'k..10,147	Montrose 1,217
Denver 133,859	Ouray 2,196
Durango 3,317	Pueblo 28,157
Elyria 1,384	Rocky Ford...2,018
Florence 3,728	Salida 3,722
Fort Collins...3,053	Silverton 1,360
Georgetown ...1,418	Telluride 2,446
Glenw'd Sp'gs.1,350	Trinidad 5,345
Globeville 2,192	Victor 4,986
Golden City...2,152	Walsenburg ..1,033
Goldfield 2,191	

Columbus, * Ohio, p. 125,560.
Combaco'num, city, India, p. 59,688.
Como, city, Italy, p. 36,426.
Com'oro Islands, bet. Madagascar and Africa, belong to France, □ 620, p. 47,000.
Concep'cion, city, Chile, p. 55,458.
Congo Free State, W. Africa, □ 900,000, p. 30,000,000 (about 2,000 whites), * Boma.
Connaught, prov. Ireland (inc. Galway, Leitrim, Mayo, Roscommon and Sligo counties), □ 6,867, p. 649,635.
Connecticut, No. Atlantic state, □ 4,949, p. 908,420, * Hartford.

Incorporated cities and towns of 1,000 pop. or more in 1900:

Ansonia 12,681	Danielson 2,823
Bethel 2,561	Derby 7,930
Branford 2,473	Greenwich 2,420
Bridgeport ...70,996	Guilford 1,512
Bristol 6,268	Hartford 79,850
Danbury 16,537	Jewett City....2,[illegible]

Connecticut.—Continued.

Litchfield 1,120	Shelton 2,837
Meriden 24,296	Southington ..3,411
Middletown ...9,589	So. Norwalk...6,591
Naugatuck ..10,541	Stafford Sp'gs.2,460
New Britain..25,998	Stamford 15,997
New Canaan..1,304	Stonington 2,278
New Haven..108,027	Torrington 8,360
New London.17,548	Wallingford ..6,737
Norwalk 6,125	Waterbury ...45,859
Norwich 17,251	West Haven...5,247
Putnam 6,667	Willimantic ...8,937
Rockville 7,287	Winsted 6,804

Constantine, city, Algeria, p. 51,997.
Constantinople, * Turkey, p. 1,125,000.
Coorg, prov. British India, □ 1,583, p. 180,461.
Copenhagen, * Denmark, p. 375,251.
Cor'doba (or Cordova), city, Spain, p. 57,312. — city, Argentine Republic, p. 47,609.
Cork, city, Ireland, p. 75,978.
Cornwall, co., Eng., □ 1,357, p. 322,960.
Coruna, city, Spain, p. 40,501.
Costa Rica, republic of Cen. Am., □ 23,000, p. 310,000, * San Jose.
Council Bluffs, Iowa, p. 25,802.
Courtrai, city, Belgium, p. 35,510.
Coventry, city, England, p. 69,877.
Covington, Ky., p. 42,938.
Cracow, city, Austria, p. 91,310.
Cremona, city, Italy, p. 38,785.
Crete (or Candia), isl. Mediterranean, under Turkish suzerainty, □ 3,326, p. 301,273. * Canea, p. 21,025.
Croatia and Slavonia, prov., Hungary, □ 16,733, p. 2,186,410, * Agram.
Cronstadt, city, Russia, p. 59,539.
Croydon, city, England, p. 138,885.
Cuba, largest of West Indian Isls., S. E. of Florida, □ 45,872, p. 1,572,797, * Havana. Cities of more than 5,000 pop. in 1899:

Caibarien 7,013	Pinar del Rio....8,880
Camajuani ... 5,082	Placitas 5,409
Cardenas 21,940	Puerto Principe 25,102
Cienfuegos ...30,038	Regla 11,363
Colon 7,175	Remedios 6,633
Gibara 6,841	Sagua la Grande 12,728
Guanabacoa ..13,965	
Guanajay 6,483	San Antonio de los Banos..... 8,178
Guantanamo . 7,137	
Guines 8,149	Sancti Spiritus.12,696
Havana 235,981	San Luis........ 5,059
Holguin 6,045	Santa Clara....13,763
Manzanillo....14,464	Santiago 43,090
Marianao 5,416	Santiago de las Vegas 7,151
Matanzas 36,374	
Melena 5,016	Trinidad 11,120

Cuddalore', city, India, p. 51,880.
Cuen'ca, city, Ecuador, p. 25,000.
Cumberland, co., Eng., □ 1,516, p. 266,960.
Cune'o, city, Italy, p. 28,793.
Curacao (Ku-ra-so'), Dutch colony off No. coast of Venezuela, inc. five islands and part of St. Martin, □ 403, p. 51,524.
Cyprus, isl. Mediterranean (British), □ 3,584, p. 209,286, * Nicosia, p. 12,515.
Czechuen, prov., China, □ 160,800, p. 67,713,000.
Czernowitz, city, Austria, p. 69,619.

D

Dacca, city, India, p. 90,679.
Dahomey, kingdom on W. coast of Africa, Fr. posses., □ 60,000, p. 1,000,000, * Porto Novo, p. 50,000.
Dallas, Texas, p. 42,638.
Dalmatia, prov., Austria, □ 4,940, p. 591,597.
Damascus, city, Syria, p. 140,500.
Damiet'ta, city, Egypt, p. 31,515.
Danzig, city, Prussia, p. 140,539.
Darbhangah', city, India, p. 65,990.
Darmstadt, * Hesse, Germany, p. 63,745.
Davenport, Iowa, p. 35,254.
Dayton, Ohio, p. 85,333.
Debreczen (da-bret'sin), city, Hungary, p. 60,000.
Delaware, So. Atlantic state, □ 2,050, p. 184,735, * Dover.
Incorporated cities and towns of 1,000 pop. or more in 1900:

Delaware City 1,132	Milford 2,500
Dover 3,329	Newark 1,213
Georgetown . 1,658	Newcastle 3,380
Harrington .. 1,242	Seaford 1,724
Laurel 1,825	Smyrna 2,168
Lewes 2,259	Wilmington ...76,508
Middletown .. 1,567	

Delhi, city, India, p. 208,385.
Denmark, kingdom of Europe, □ 15,289, p. 2,447,441, * Copenhagen.
Denbigh, co., Wales, □ 663, p. 131,588.
Denver, * Colo., p. 133,859.
Derby, co., Eng., □ 1,022, p. 504,755.—Its * p. 105,785.
Des Moines, * Iowa, p. 62,139.
Des'sau, * Anhalt, Germany, p. 42,375.
Detroit, Mich., p. 285,704.
Dev'on, co., Eng., □ 2,597, p. 437,210.
Devonport, town, Eng., p. 69,674.
Diar'bekr, city, Kurdistan, p. 34,000.
Dijon', city, France, p. 67,736.
District of Columbia, federal ter. U. S., □ 70, p. 278,718; Washington, * U. S. A., is co-extensive with the District.
Dorset, co., Eng., □ 988, p. 202,092.
Dortmund, city, Prussia, p. 142,418.
Douai (doo-a'), city, France, p. 31,397.
Dresden, city, Saxony, p. 395,349.
Dublin, * Ireland, p. 289 108.
Dubuque, Iowa, p. 36,297.
Dudley, town, Eng., p. 48,809.
Du'isburg, city, Prussia, p. 70,272.
Duluth, Minn., p. 52,969.
Dunaburg (Dvinsk), city, Russia, p. 72,231.
Dundee, city, Scotland, p. 160,871.
Dunfermline (dun-fer'lin), town, Scotland, p. 25,250.
Dunkerque', city, France, p. 39,718.
Durango, state, Mexico, □ 38,009, p. 292,549. — Its * p. 31,092.
Durban', city, Natal, So. Africa, p. 39,245.
Durham, co., Eng., □ 999, p. 833,614.
Dusseldorf, city, Prussia, p. 213,767.
Dutch East Indies, belong to Netherlands, comprise parts of Sumatra, Java, Madura, Riau-Lingga Arch., Banca, Billiton, Borneo, Celebes, Moluccas, Timor, Bali, Lombok, New Guinea, etc., □ 736,400, p. 34,000,000, * Batavia (Java), p. 115,567.
Dutch Guiana, So. Am., □ 46,060, p. 66,490, * Paramaribo, p. 31,200.

E

East Africa, British (inc. E. Africa Protectorate and Uganda Protectorate), □ 1,000,000 (est.).
Easton, Pa., p. 25,238.
East St. Louis, Ill., p. 29,655.
East Turkestan, dep. Chinese Empire, □ 431,800, p. 580,000.
Ecuador, republic of So. Am., □ 120,000, p. 1,270,000, * Quito.
Edinburgh, * Scotland, p. 316,479.
Egypt, prov. under Turkish suzerainty, □ 400,000 (excluding Sudan), p. 9,734,405, * Cairo.
Egyptian Sudan, part of Sudan, So. of 22° N. lat., ruled jointly by Egypt and Great Britain, □ 950,000, p. 10,000,000, * Khartum.
Elberfeld, city, Prussia, p. 156,937.
Elizabeth, N. J., p. 52,130.
Elizabethgrad, city, Russia, p. 61,841.
Elmira, N. Y., p. 35,672.
Erie, Pa., p. 52,733.
Ely, Isle of, Cambridge co., Eng., □ 374, p. 64,499.
England and Wales, □ 58,309, p. 32,526,075.
Erfurt, city, Prussia, p. 78,174.
Eritrea, Africa, Italian colony on Red Sea, □ 88,500 p. 450,000, * Asmara.
Erzerum, city, Armenia, p. 38,900.
Essen, city, Prussia, p. 118,863.
Essex, co., Eng., □ 1,533, p. 816,503.
Ethiopia, ancient name of Abyssinia.

Europe, continent, □ 3,797,410, p. 380,000,000.
Evansville, Ind., p. 59,007.
Exeter, town, Eng., p. 46,940.

F

Faiza'bad, city, India, p. 74,076.
Falkirk, town, Scotland, p. 29,271.
Falkland Islands, British Crown Colony, So. Atlantic, □ 7,500, p. 1,759, * Stanley, p. 789.
Fall River, Mass., p. 104,863.
Farukhabad', city, India, p. 62,878.
Fayoum', city, Egypt, p. 33,069.
Federal District, Mexico, □ 463, p. 468,705.
Ferrara, city, Italy, p. 91,259.
Ferrol, city, Spain, p. 35,975.
Fez, * Morocco, p. 140,000.
Fezzan (ancient Phazania), prov. in So. part of Tripoli, in desert region.
Fiji Islands, So. Pacific (about 200 islands), British, □ 8,045, p. 122,673, * Suva.
Finland, grand-duchy, Russia, □ 144,255, p. 2,483,249.
Fitchburg, Mass., p. 31,531.
Fium'e, town and prov., Hungary, □ 8, p. 30,000.
Flint, co., Wales, □ 256, p. 81,490.
Florence, city, Italy, p. 216,051.
Florida, So. Atlantic state, □ 58,680, p. 528,542, * Tallahassee.
Incorporated cities and towns of 1,000 pop. or more in 1900:

Apalachicola	3,077	Miami	1,681
Bartow	1,983	Milton	1,204
Daytona	1,690	Monticello	1,076
De Land	1,449	Ocala	3,380
Fernandina	3,245	Orlando	2,481
Fort Brook	1,135	Palatka	3,301
Gainesville	3,633	Pensacola	17,747
High Springs	1,562	Port Tampa Cy.	1,367
Jacksonville	28,429	St. Augustine	4,272
Key West	17,114	St. Petersburg	1,575
Kissimmee	1,132	Sanford	1,450
Lake City	4,013	Tallahassee	2,981
Lakeland	1,108	Tampa	15,839
Live Oak	1,659	West Tampa	2,355

Foggia (fod'ja), city, Italy, p. 50,374.
Forli', city, Italy, p. 47,082.
Formosa, isl. in China Sea, belongs to Japan, □ 13,458, p. 2,745,138.
Fort Wayne, Ind., p. 45,115.
Fort Worth, Texas, p. 26,688.
France, republic of W. Europe, □ 204,092, p. 38,641,333, * Paris.
Frankfort-on-Main, city, Prussia, p. 288,489.
Frankfort-on-Oder, city, Prussia, p. 59,161.
Franklin, ter. Canada (isls. N. Canada).
Freetown, * Sierra Leone, p. 30,033.
Freiburg, city, Baden, Germany, p. 53,118. — city, Saxony, p. 29,987.
French Congo, Fr. posses. on W. coast of Africa, □ 450,000, p. 8,000,000.
French Guiana, colony, So. Am., □ 46,850, p. 30,300, * Cayenne, p. 12,300.
French Guinea, on African coast, □ 95,000, p. 2,200,000, * Konakry.
French Somali Coast, E. Africa, □ 45,000, p. 22,000, * Jibuti.
Fu'chau, city, China, on Min R., p. 650,000.
Fu'kien, prov., China, □ 41,300, p. 22,191,000.
Fuku'i, city, Japan, p. 44,286.
Fukuo'ka, city, Japan, p. 66,190.
Fula Empire, included in Nigeria, W. Africa.
Furth, city, Bavaria, Germany, p. 46,771.

G

Ga'latz, city, Rumania, p. 62,678.
Galicia, prov., Austria, □ 30,307, p. 7,295,538.
Galle (gawl), city, Ceylon, p. 33,596.
Gal'veston, Tex., p. 37,789.
Gambia, British W. Africa, crown colony, □ 69, p. 15,000, *Bathurst, p. 6,000.
Gateshead, city, Eng., p. 109,887.
Gaya', city, India, p. 71,186.
Gefle *(yev'la)*, city, Sweden, p. 28,308.
Gen'oa *(It. Geno'va), city*, Italy, p. 237,486.
Geneva, city, Switzerland, p. 104,044.
Georgetown, * British Guiana, p. 53,176.
Georgia, So. Atlantic state, □ 59,475, p. 2,216,331, * Atlanta.
Incorporated cities and towns of 1,000 or more in 1900:

Abbeyville	1,152	Hawkinsville	2,103
Albany	4,606	Jackson	1,487
Americus	7,674	La Grange	4,274
Ashburn	1,301	Lithonia	1,208
Athens	10,245	Louisville	1,009
Atlanta	89,872	Lumpkin	1,470
Augusta	39,441	McRae	1,020
Bainbridge	2,641	Macon	23,272
Barnesville	3,036	Madison	1,992
Blue Ridge	1,148	Marietta	4,446
Brunswick	9,081	Milledgeville	4,219
Buena Vista	1,161	Monroe	1,846
Buford	1,352	Monticello	1,106
Camilla	1,051	Moultrie	2,221
Carrollton	1,998	Newnan	3,654
Cartersville	3,135	Quitman	2,281
Cedartown	2,823	Richland	1,014
Cochran	1,531	Rome	7,291
Columbus	17,614	Roswell	1,329
Conyers	1,605	Sandersville	2,023
Cordele	3,473	Savannah	54,244
Covington	2,062	Seville	1,277
Cuthbert	2,641	Social Circle	1,229
Dahlonega	1,255	Sparta	1,150
Dalton	4,315	Statesboro	1,197
Darien	1,739	Summerville Richmond co.	3,245
Dawson	2,926	Talbottom	1,131
Decatur	1,418	Tallapoosa	2,128
Douglasville	1,140	Tennille	1,121
Dublin	2,987	Thomaston	1,714
Eastman	1,235	Thomasville	5,322
East Point	1,315	Thomson	1,154
Eatonton	1,823	Tifton	1,384
Edgewood	1,285	Toccoa	2,176
Elberton	3,834	Trion	1,926
Fitzgerald	1,817	Valdosta	5,613
Forsyth	1,172	Vienna	1,035
Fort Gaines	1,305	Warrenton	1,113
Fort Valley	2,022	Washington	3,300
Gainesville	4,382	Waycross	5,919
Greensboro	1,511	Waynesboro	2,030
Griffin	6,857	West Point	1,797
Harmony Grove	1,454	Winder	1,145
Hartwell	1,672	Wrightsville	1,127

Gera, * Reuss, Jüngere Linie, Germany, p. 43,544.
Gergenti, city, Italy, p. 25,441.
German East Africa, German dep., □ 384,180, p. 8,000,000, * Bagamoyo, p. 13,000.
German Empire, Europe, □ 208,830, p. 56,345,014, * Berlin.
German South-West Africa, German dep., □ 322,450, p. 200,000, * Great Windhoek.
Ghent, city, Belgium, p. 163,030.
Gibraltar, British crown colony on Mediterranean, □ 1.9, p. 24,701.
Gijon (he-hone'), city, Spain, p. 43,392.
Glamor'gan, co., Wales, □ 790, p. 601,092.
Glasgow, city, Scotland, p. 760,423.
Gloucester, Mass., p. 26,121. — co., Eng., □ 1,236, p. 331,516. — its * p. 47,943.
Goa, Portuguese ter. in India, □ 1,390, p. 494,836, * Panjin.
Gold Coast, British W. Africa, crown colony, □ 40,000, p. (est.) 1,473,882, * Accra, p. 16,267.
Gorakhpur', city, India, p. 63,059.
Gorlitz, city, Prussia, p. 70,175.
Go'teborg, city, Sweden, p. 126,849.
Gotha (go'ta), * Saxe-Coburg and Gotha, Germany, p. 31,671.
Gov'an, city, Scotland, p. 76,351.
Granada, city, Spain, p. 75,054.
Grand Rapids, Mich., p. 87,565.
Gratz, city, Austria, p. 138,370.
Great Britain and Ireland, see United Kingdom.
Greece, kingdom of Europe, □ 25,014, p. 2,433,806, * Athens.
Greenland, isl., N. E. of No. Am., belongs to Denmark, □ 46,740, p. 10,516.

Greenock, city, Scotland, p. 67,645.
Greiz, * Reuss, Aeltere Linie, Germany, p. 22,296.
Greno'ble, city, France, p. 64,002.
Grimsby, town, Eng., p. 63,138.
Groningen, city, Holland, p. 66,739.
Guadalajara (—ha'ra), city, Mexico, p. 101,-413.
Guadeloupe, isl., Lesser Antilles, belongs to France, □ 583, p. (with dependencies) 167,000.
Guam, isl., largest of Ladrones (U. S.), □ 200, p. 9,000, * Agaña, p. 6,000.
Guanajuato (—hwa'to), state, Mexico, □ 11,-370, p. 1,047,817, — its * p. 39,404.
Guatema'la, republic, Cen. Am., □ 48,290, p. 1,574,340, * Guatemala la Nueva, p. 72,102.
Guayaquil (gwi-a-keel'), city, Ecuador, p. 50,000.
Guerre'ro, state, Mexico, □ 24,996, p. 417,886.

H

Haarlem, city, Holland, p. 64,836.
Haidara'bad, state, India, □ 82,698, p. 11,174,-897, — its * p. 446,291.
Haiti, republic, W. part of Isl. of Haiti, □ 10,204, p. 1,210,625, * Port-au-Prince.
Hakoda'te, city, Japan, p. 78,040.
Halifax, * prov. Nova Scotia, Canada, p. 40,787. — city, Eng., p. 104,933.
Halle-on-Saale, city, Prussia, p. 156,611.
Hamburg, Ger. state and free city, □ 158, p. 768,349.
Hamilton, city, Canada, p. 52,550. — town, Scotland, p. 32,775.
Hankow, city, China, on Yangtse R., p. (est.) 800,000.
Hanley, town, Eng., p. 61,524.
Hanover, city, Prussia, p. 235,666. — prov. Prussia, p. 2,590,336.
Harrisburg, * Pa., p. 50,167.
Hartford, * Conn., p. 79,850.
Hastings, town, Eng., p. 65,528.
Havana, * Cuba, p. 235,981.
Haverhill, Mass., p. 37,175.
Havre (ha'ver) (or Le Havre) (le-av'r), city, France, p. 129,000.
Hawaii, group of isles, Pacific Ocean, ter. of U. S., □ 6,449, p. 154,001, * Honolulu, p. 39,306.

Area and population of the inhabited islands:

	Area.	Pop.
Hawaii	4,210	46,843
Kauai and Niihau..............	687	20,734
Lanai and Maui................	910	25,416
Molokai	270	2,504
Oahu	600	58,504
Kahoolawe	63	......

Hedjas, Turkish prov. Arabia, □ 96,500, p. 300,000.
Heidelberg, city, Baden, Germany, p. 35,190.
Heilbronn', city, Wurtemberg, Germany, p. 33,461.
Helsingfors, city, Finland, p. 77,484.
Herat', city, Afghanistan, p. 40,000.
Hereford, co., England, □ 840, p. 114,150.
Hertford, co., Eng., □636, p. 258,045.
Herzegovi'na, see Bosnia.
Hesse, Ger. Grand-duchy, □ 2,965, p. 1,120,-426, * Darmstadt.
Hidal'go, state, Mex., □ 8,917, p. 551,817.
Hindustan', Persian name of India, see India.
Hiroshi'ma, city, Japan, p. 122,306.
Hobart, * Tasmania, p. 24,905.
Ho'boken, N. J., p. 59,364.
Hodmeso-Vasarhely (hod-mey-zo-va-sar-hail'), city, Hungary, p. 60,789.
Hof, city, Bavaria, Germany, p. 27,556.
Holland, kingdom, see Netherlands.
Hol'yoke, Mass., p. 45,712.
Honan', prov., China, □ 61,300, p. 22,116,000.
Hondur'as, republic, Cen. Am., □ 46,250, p. 407,000, * Tegucigalpa.
Hongkong', isl., S. E. coast of China, British crown colony, □ 29, p. 254,400, * Victoria.
Honolu'lu, * Hawaii, p. 39,306.
Houston, Tex., p. 44,633.
Howrah, city, India, p. 157,847.
Hubli, city, India, p. 58,149.
Huddersfield, city, Eng., p. 95,008.
Hu'nan, prov., China, □ 74,400, p. 21,003,000.
Hungary, kingdom, part of Austria-Hungary, □ 125,039, p. 19,203,531, * Budapest.
Huntingdon, co., Eng., □ 366, p. 54,127.
Hu'peh, prov., China, □ 65,900, p. 32,245,000.

I

Iceland, isl., E. of Greenland, belongs to Denmark, □ 39,756, p. 70,927.
Ichang', city, China, on Yangste R., p. 35,000.
Idaho, W. state, □ 84,800, p. 161,772, * Boise.
Incorporated cities and towns of 1,000 pop. or more in 1900:

Boise	5,957	Moscow	2,484
Grangeville	1,132	Pocatello	4,046
Idaho Falls	1,262	Rexburg	1,081
Lewiston	2,425	Wallace	2,265
Malade	1,050	Weiser	1,364
Montpelier	1,444		

Illinois, No. central state, □ 56,650, p. 4,821,-550, * Springfield.
Incorporated cities and towns of 1,000 pop. or more in 1900:

Abingdon	2,022	Coal City	2,607
Albion	1,162	Cobden	1,034
Aledo	2,081	Colchester	1,635
Altamont	1,335	Colfax	1,153
Alton	14,210	Collinsville	4,021
Amboy	1,826	Columbia	1,197
Anna	2,618	Crotty	1,036
Arcola	1,995	Cuba	1,198
Arlingt'n H'ts	1,380	Danville	16,354
Ashland	1,201	Decatur	20,754
Assumption	1,702	Dekalb	5,904
Astoria	1,684	Delavan	1,304
Athens	1,535	Des Plaines	1,666
Atlanta	1,270	Dixon	7,917
Auburn	1,281	Dolton	1,229
Augusta	1,149	Downer's G've	2,103
Aurora	24,147	Duquoin	4,353
Averyville	1,573	Dwight	2,015
Barrington	1,162	Earlville	1,122
Barry	1,643	E. Dubuque, C	1,146
Batavia	3,871	E. Dubuque, V	1,417
Beardstown	4,827	E. St. Louis	29,655
Belleville	17,484	Edinburg	1,071
Belvidere	6,937	Edwardsville	4,157
Bement	1,484	Effingham	3,774
Benton	1,341	Eldorado	1,445
Bloomington	23,286	Elgin	22,433
Blue Island	6,114	Elmhurst	1,728
Braceville	1,669	Elmwood	1,582
Bradley	1,518	El Paso	1,441
Braidwood	3,279	Eureka	1,661
Breese	1,571	Evanston	19,259
Brooklyn	1,019	Fairbury	2,187
Bunker Hill	1,279	Fairfield	2,338
Bushnell	2,490	Farmer City	1,664
Byron	1,015	Farmington	1,729
Cairo	12,566	Flora	2,311
Cambridge	1,345	Forreston	1,047
Camp Point	1,260	Fort Sheridan	1,575
Canton	6,564	Freeburg	1,214
Carbondale	3,318	Freeport	13,258
Carbon Hill	1,256	Fulton	2,685
Carlinville	3,502	Galena	5,005
Carlyle	1,874	Galesburg	18,607
Carmi	2,939	Galva	2,682
Carpent'sville	1,002	Gardner	1,036
Carrollton	2,355	Geneseo	3,356
Carterville	1,749	Geneva	2,246
Carthage	2,104	Genoa	1,140
Casey	1,500	Germantown	1,782
Centralia	6,721	Gibson	2,054
Cerro Gordo	1,008	Gilman	1,441
Champaign	9,098	Girard	1,661
Charleston	5,488	Glencoe	1,020
Chatsworth	1,038	Golconda	1,140
Chenoa	1,512	Granite	3,122
Chester	2,832	Grayville	1,948
Chicago	1,698,575	Greenfield	1,085
Chicago H'g'ts	5,100	Greenup	1,085
Chillicothe	1,099	Greenview	1,019
Clinton	4,452	Greenville	2,504

Illinois.—Continued.

Griggsville ...1,404
Grossdale 1,111
Hamilton 1,344
Harlem 4,085
Harrisburg ..2,202
Harvard 2,602
Harvey 5,395
Havana 3,268
Henry 1,637
Herrin 1,559
Highland 1,970
Highland Pk..2,806
Hillsboro 1,937
Hinsdale 2,578
Homer 1,080
Hoopeston ...3,823
Jacksonville 15,078
Jerseyville ...3,517
Joliet 29,353
Jonesboro 1,130
Kangley 1,004
Kankakee ...13,595
Kansas 1,049
Keithsburg ...1,566
Kewanee 8,382
Kinmundy ...1,221
Kirkwood 1,008
Knoxville 1,857
Lacon 1,601
Ladd 1,324
Lagrange 3,969
La Harpe.....1,591
Lake Forest..2,215
Lanark 1,306
Lasalle 10,446
Lawrenceville 1,300
Lebanon 1,812
Lemont 2,449
Lena 1,252
Leroy 1,629
Lewistown ...2,504
Lexington 1,415
Lincoln 8,962
Litchfield 5,918
Lockport 2,659
McHenry 1,013
Mc Leansboro.1,758
Macomb 5,375
Madison 1,979
Marengo 2,005
Marion 2,510
Marissa 1,066
Maroa 1,213
Marseilles 2,559
Marshall 2,077
Martinsville ..1,000
Mascoutah ...2,171
Mason City...1,890
Mattoon 9,622
Maywood 4,532
Melrose Park.2,592
Mendota 3,736
Metropolis ...4,069
Milford 1,077
Millstadt 1,172
Minonk 2,545
Moline 17,248
Momence 2,026
Monmouth 7,460
Monticello 1,982
Morgan Park..2,329
Morris 4,273
Morrison 2,308
Mound City...2,705
Mt. Carmel...4,311
Mt. Carroll....1,965
Mt. Morris....1,048
Mt. Olive.....2,935
Mt. Pulaski...1,643
Mt. Sterling..1,960
Mt. Vernon...5,216
Moweaqua 1,478
Murphysboro 6,463
Naperville ...2,629
Nashville 2,184
Nauvoo 1,321
Neoga 1,126
Newman 1,166

Newton 1,630
Nilwood 1,378
Nokomis 1,371
Normal 3,795
North Chicago 1,150
North Peoria.2,358
North Utica..1,150
Oakland 1,198
Odell 1,000
Odin 1,180
O'Fallon 1,267
Olney 4,260
Onarga 1,270
Oquawka 1,010
Oregon 1,577
Ottawa 10,588
Palatine 1,020
Pana 5,530
Paris 6,105
Park Ridge....1,340
Paxton 3,036
Pecatonica ...1,045
Pekin 8,420
Peoria 56,100
Peotone 1,003
Peru 6,863
Petersburg ...2,807
Pinckneyville 2,357
Pittsfield 2,293
Plano 1,634
Polo 1,869
Pontiac 4,266
Princeton 4,023
Prophetstown 1,143
Quincy 36,252
Rantoul 1,207
Redbud 1,169
Ridgely 1,169
River Forest..1,539
Riverside 1,551
Riverton 1,511
Robinson 1,683
Rochelle 2,073
Rock Falls....2,176
Rockford 31,051
Rock Island..19,493
Roodhouse ...2,351
Roseville 1,014
Rossville 1,435
Rushville 2,292
St. Anne......1,000
St. Charles...2,675
St. Elmo......1,050
Salem 1,642
Sandoval 1,258
Sandwich 2,520
Savanna 3,325
Shawneetown 1,698
Sheffield 1,265
Shelbyville ...3,546
Sheldon 1,103
Sorento 1,000
Sparta 2,941
Springfield ..34,159
Spring Valley.6,214
Staunton 2,786
Sterling 6,309
Streator 14,079
Sullivan 2,399
Sumner 1,263
Sycamore 3,653
Taylorville ...4,248
Toluca 2,629
Toulon 1,057
Trenton 1,706
Troy 1,080
Tuscola 2,569
Upper Alton..2,373
Urbana 5,728
Vandalia 2,665
Venice 2,450
Vermont 1,195
Vienna 1,217
Virden 2,280
Virginia 1,600
Warren 1,327
Warsaw 2,335
Washington ..1,459

Illinois.—Continued.

Waterloo 2,114
Watseka 2,505
Waukegan 9,426
Waverly 1,573
Wenona 1,486
West Chicago 1,877
West Dundee 1,348
W. Hammond 2,935
Westville 1,605
Wheaton 2,345
Whitehall 2,030
Wilmette 2,300
Wilmington ..1,420
Winchester ...1,711
Winnetka 1,833
Winstanley Park 1,055
Woodstock ...2,502
Wyoming 1,277

India, Asiatic empire, belongs to Great Britain, □ 1,559,603, p. 291,628,307, • Calcutta.

Indiana, No. central state, □ 36,350, p. 2,516,462, • Indianapolis.

Incorporated cities and towns of 1,000 pop. or more in 1900:

Albany 2,116
Albion 1,324
Alexandria ...7,221
Anderson 20,178
Angola 2,141
Arcadia 1,413
Argos 1,307
Ashley 1,040
Atlanta 1,000
Attica 3,005
Auburn 3,396
Aurora 3,645
Batesville 1,384
Bedford 6,115
Bern 1,037
Bloomfield 1,588
Bloomington . 6,460
Bluffton 4,479
Boonville 2,849
Bourbon 1,187
Brazil 7,786
Bremen 1,671
Brookville 2,037
Brownstown ..1,685
Butler 2,063
Cambridge City 1,754
Cannelton 2,188
Carthage 1,028
Cicero 1,603
Clarksville 2,370
Clay City......1,503
Clinton 2,918
Columbia City.2,975
Columbus 8,130
Connersville ..6,836
Converse 1,415
Corydon 1,610
Covington 2,213
Crawfordsville 6,649
Crown Point...2,336
Danville 1,802
Decatur 4,142
Delphi 2,135
Dunkirk 3,187
East Chicago..3,411
Eaton 1,567
Edinburg 1,820
Elkhart 15,184
Elwood 12,950
Evansville ...59,007
Fairmount 3,205
Flora 1,209
Fortville 1,006
Fort Wayne..45,115
Fowler 1,429
Frankfort 7,100
Franklin 4,005
Frankton 1,464
Garrett 3,910
Gas City.......3,622
Geneva 1,076
Goodland 1,205
Goshen 7,810
Greencastle ...3,661
Greenfield 4,489
Greensburg ...5,034
Greentown 1,287
Greenwood ...1,503
Hammond ...12,376
Hartford 5,912
Hobart 1,390

Hope 1,088
Howell 1,421
Huntingburg .2,527
Huntington ...9,491
Indianapolis 169,164
Irvington 1,799
Jasper 1,863
Jeffersonville 10,774
Jonesboro 1,838
Kendallville ..3,354
Kentland 1,006
Knightstown ..1,942
Knightsville ..1,171
Knox 1,466
Kokomo 10,609
Ladoga 1,176
Lafayette 18,116
Lagrange 1,703
Laporte 7,113
Lawrenceburg 4,326
Lebanon 4,465
Liberty 1,449
Ligonier 2,231
Linton 3,071
Logansport ..16,204
Loogootee 1,382
Lowell 1,275
Madison 7,835
Marion 17,337
Martinsville ..4,038
Michigan City 14,850
Middletown ...1,801
Mishawaka ...5,560
Mitchell 1,772
Monon 1,160
Montezuma ...1,172
Monticello 2,107
Montpelier 3,405
Mt. Vernon....5,132
Muncie 20,942
Nappanee 2,208
New Albany..20,628
Newburg 1,371
New Castle....3,406
New Harmony 1,341
Noblesville ...4,792
North Manchester .2,398
North Vernon 2,823
Oakland 1,991
Orleans 1,236
Osgood 1,035
Owensville ...1,019
Paoli 1,186
Pendleton 1,512
Peru 8,463
Petersburg 1,751
Plymouth 3,656
Port Fulton..-1,101
Portland 4,798
Princeton 6,041
Redkey 2,206
Remington ...1,120
Rensselaer ...2,255
Richmond ...18,226
Ridgeville 1,098
Rising Sun....1,548
Rochester 3,421
Rockport 2,882
Rockville 2,045
Rushville 4,541
Salem 1,995

Indiana.—Continued.

Scottsburg 1,274	Valparaiso ...6,280
Seymour 6,445	Veedersburg ..1,638
Shelbyville ...7,169	Vevay 1,588
Sheridan 1,795	Vincennes 10,249
South Bend...35,999	Wabash 8,618
South Whitley.1,113	Walkerton 1,037
Spencer 2,026	Warren 1,523
Sullivan 3,118	Warsaw 3,987
Summitville ..1,432	Washington ..8,551
Swayzee 1,162	Waterloo 1,244
Tell City.......2,680	W. Lafayette..2,302
Terre Haute..36,673	Whiting 3,983
Thorntown 1,511	Williamsport .1,245
Tipton 3,764	Winamac 1,684
Union City....2,716	Winchester ...3,705
Upland 1,208	Worthington ..1,448

Indian Territory, So. central part of U. S., □ 31,400, p. 392,060.

Incorporated cities and towns of 1,000 pop. or more in 1900:

Ardmore 5,681	Pauls Valley. .1,467
Chickasha 3,209	Poteau 1,182
Coalgate 2,614	Purcell 2,277
Davis 1,346	So. McAlester 3,479
Duncan 1,164	Sulphur Spgs..1,198
Durant 2,969	Tahlequah 1,482
Hartshorne ...2,352	Tulsa 1,390
Lehigh 1,500	Vinita 2,339
Marlow 1,016	Wagoner 2,372
Miami 1,527	Wynnewood ..1,907
Muscogee 4,254	

Iowa, No. central state, □ 56,025, p. 2,231,-853, • Des Moines.

Incorporated cities and towns of 1,000 pop. or more in 1900:

Ackley 1,445	Eaglegrove 3,557
Adel 1,213	Eddyville 1,230
Afton 1,178	Eldon 1,850
Akron 1,029	Eldora 2,233
Albia 2,889	Elkader 1,321
Algona 2,911	Emmetsburg ..2,361
Alton 1,009	Estherville ...3,237
Ames 2,422	Fairfield 4,689
Anamosa 2,891	Farmington ...1,332
Atlantic 5,046	Fayette 1,315
Audubon 1,866	Fonda 1,180
Avoca 1,627	Forest City....1,758
Bedford 1,977	Fort Dodge...12,162
Belle Plaine...3,283	Fort Madison.9,278
Bellevue 1,607	Garner 1,288
Belmond 1,234	Glenwood 3,040
Bloomfield 2,105	Grand Junction 1,113
Boone 8,880	Green 1,192
Britt 1,540	Greenfield 1,300
Brooklyn 1,188	Grinnell 3,860
Burlington ...23,201	Grundy Center1,322
Calmar 1,003	Guthrie Center 1,193
Carroll 2,882	Guttenberg ...1,620
Cascade 1,266	Hamburg 2,079
Cedar Falls....5,319	Hampton 2,727
Cedar Rapids 25,656	Harlan 2,422
Centerville ...5,256	Hartley 1,006
Chariton 3,989	Hawarden 1,810
Charles City...4,227	Hedrick 1,035
Cherokee 3,865	Humboldt 1,474
Cincinnati 1,212	Ida Grove.....1,967
Clarinda 3,276	Independence 3,656
Clarion 1,475	Indianola 3,261
Clear Lake....1,706	Iowa City.....7,987
Clinton 22,698	Iowa Falls.....2,840
Colfax 2,053	Jefferson 2,601
Columbus Junction 1,099	Keokuk 14,641
Coon Rapids...1,017	Keosauqua ...1,117
Corning 2,145	Knoxville 3,131
Corydon 1,477	Lake City......2,703
Council Bluffs 25,802	Lake Mills.....1,293
Cresco 2,806	Lamoni 1,540
Creston 7,752	Lansing 1,438
Davenport ...35,254	Laporte 1,419
Decorah 3,246	Le Mars.. 4,146
Denison 2,771	Lenox 1,014
Des Moines...62,139	Leon 1,905
Dewitt 1,383	Logan 1,377
Dubuque 36,297	Lucas 1,132
Dunlap 1,355	McGregor 1,498
Dyersville 1,323	Madrid 1,020

Iowa.—Continued.

Malvern 1,166	Rockwell City.1,222
Manchester ...2,887	Sabula 1,029
Manning 1,169	Sac City.......2,079
Manson 1,424	Sanborn 1,247
Mapleton 1,099	Seymour 1,703
Maquoketa 3,777	Sheldon 2,282
Marengo 2,007	Shenandoah ..3,573
Marion 4,102	Sibley 1,289
Marshalltown 11,544	Sidney 1,143
Mason City....6,746	Sigourney 1,952
Missouri Valley 4,010	Sioux City....33,111
Montezuma ...1,210	Sioux Rapids..1,005
Monticello ...2,104	Spencer 3,095
Moulton 1,420	Spirit Lake....1,219
Mt. Ayr........1,729	State Center...1,008
Mt. Pleasant..4,109	Storm Lake...2,169
Mt. Vernon....1,629	Story City.....1,197
Muscatine ...14,073	Strawberry Point 1,012
Mystic 1,758	Stuart 2,079
Nashua 1,268	Sumner 1,437
Nevada 2,472	Tama 2,649
New Hampton.2,339	Tipton 2,513
New London..1,003	Toledo 1,941
New Sharon...1,252	Traer 1,458
Newton 3,682	Valley Junction 1,700
Nora Springs..1,209	Villisca 2,211
Northwood 1,271	Vinton..........3,499
Odebolt 1,432	Wapello 1,398
Oelwein 5,142	Washington ...4,255
Onawa 1,933	Waterloo 12,580
Orange City...1,457	Waukon 2,153
Osage 2,734	Waverly 3,177
Osceola 2,505	Webster City..4,613
Oskaloosa 9,212	W. Burlington.1,044
Ottumwa 18,197	West Liberty..1,690
Parkersburg ..1,164	West Union...1,935
Pella 2,623	What Cheer...2,746
Perry 3,986	Williamsburg 1,100
Red Oak.......4,355	Wilton 1,233
Reinbeck 1,203	Winterset 3,039
Rockford 1,080	Woodbine 1,255
Rock Rapids..1,766	
Rock Valley...1,054	

Ipswich, town, Eng., p. 66,622.

Iquique (e-ke'kay), city, Chile, p. 38,852.

Ireland, one of British Isles, □ 32,583, p. 4,-456,546, • Dublin.

Irkutsk', city, Siberia, p. 51,484.

Isle of Wight, Southampton co., So. coast of Eng., □ 146, p. 82,388.

Ispahan', city, Persia, p. 80,000.

Italian Somali-Land, Africa, protectorate, □ 100,000, p. 400,000.

Italy, kingdom of So. Europe, □ 110,646, p. 32,449,754, • Rome.

Ivano'vo-Voznesensk', city, Russia, p. 53,949.

Ivory Coast, Africa, E. of Liberia, Fr. posses., □ 125,000, p. 2,500,000, • Grand Bassam.

J

Jabal'pur, city, India, p. 89,708.

Jackson, Mich., p. 25,180.

Jacksonville, Fla., p. 28,429.

Jaffna, city, Ceylon, p. 43,179.

Jaipur, city, India, p. 159,550.

Jalisco, state, Mexico, □ 31,846, p. 1,094,569.

Jamaica, Brit. W. Indies., 90 miles So. of Cuba, □ 4,200, p. 745,104, • Kingston, p. 46,542.

Japan, isl., empire, E. of Japan sea, Asia, □ 147,655 (with Formosa and Pescadores Isl., □ 161,198), p. 43,760,815 (with above islands, 43,558,358), • Tokyo.

Jassy, city, Rumania, p. 78,067.

Java, isl., Dutch E. Indies, □ 49,224, p. 26,-125,000, • Batavia.

Jeres (ha'reth), city, Spain, p. 60,004.

Jersey City, N. J., p. 206,433.

Jerusalem, city, Syria, p. 42,000.

Jhan'si, city, India, p. 55,288.

Jodh'pur (joth'—), city, India, p. 60,437.

Johan'nesburg, city, Transvaal, p. 102,078.

Johnstown, Pa., p. 35,936.

Johore', state, Malay pen. (British), □ 9,000, p. 200,000, • Johore Bahru.

Joliet, Ill., p. 29,353.
Joplin, Mo., p. 26,023.
Jungaria, depend. Chinese Empire, □ 147,950, p. 600,000.

K

Ka'bul, * Afghanistan, on Kabul R., p. 70,000.
Kagoshima, city, Japan, p. 53,481.
Kaisarieh, city, Asia Minor, p. 72,000.
Kaiserslautern, city, Bavaria, Germany, p. 48,329.
Kaiser Wilhelm's Land, No. section of S. E. N. Guinea, German protectorate, □ 70,000, p. 110,000.
Kalat, * Baluchistan.
Kameruns, Africa, German depend., □ 191,130, p. 3,500,000, * Kamerun.
Kanazawa, city, Japan, p. 83,266.
Kansas, No. central state, □ 82,080, p. 1,470,495, * Topeka.
Incorporated cities and towns of 1,000 pop. or more in 1900:

Abilene	2,507	Kingman	1,785
Anthony	1,179	Lacygne	1,037
Argentine	5,878	Larned	1,583
Arkansas City	6,140	Lawrence	10,862
Atchison	15,722	Leavenworth	20,735
Augusta	1,197	Lincoln	1,262
Baldwin	1,017	Lindsborg	1,279
Baxter Spgs.	1,641	Lyndon	1,004
Belleville	1,983	Lyons	1,726
Beloit	2,359	McPherson	2,996
Blue Rapids	1,160	Manhattan	3,438
Burlingame	1,436	Marion	1,824
Burlington	2,418	Marysville	2,006
Caldwell	1,574	Minneapolis	1,727
Chanute	4,208	Neodesha	1,772
Cherokee	1,226	Newton	6,208
Cherryvale	3,472	Nickerson	1,038
Chetopa	2,019	Norton	1,202
Clay Center	3,069	Olathe	3,451
Clyde	1,157	Osage	2,792
Coffeyville	4,953	Osawatomie	4,191
Columbus	2,310	Osborne	1,075
Concordia	3,401	Oswego	2,208
Council Grove	2,265	Ottawa	6,934
Dodge	1,942	Paola	3,144
Eldorado	3,466	Parsons	7,682
Ellsworth	1,549	Peabody	1,369
Emporia	8,223	Phillipsburg	1,008
Empire	2,258	Pittsburg	10,112
Erie	1,111	Pleasanton	1,097
Eureka	2,091	Pratt	1,213
Florence	1,178	Rosedale	3,270
Fort Scott	10,322	Russell	1,143
Frankfort	1,167	Sabetha	1,646
Fredonia	1,650	St. Marys	1,390
Frontenac	1,806	St. Paul	1,047
Galena	10,155	Salina	6,074
Garden	1,590	Scammon	1,549
Garnett	2,078	Scranton	1,099
Girard	2,473	Sedan	1,067
Goodland	1,059	Seneca	1,846
Great Bend	2,470	Smith Center	1,142
Harper	1,151	Stafford	1,068
Hays	1,136	Sterling	2,002
Herington	1,607	Stockton	1,030
Hiawatha	2,829	Strong	1,128
Holton	3,082	Topeka	33,608
Horton	3,398	Valley Falls	1,078
Howard	1,207	Wamego	1,618
Humboldt	1,402	Washington	1,575
Hutchinson	9,379	Weir	2,977
Independence	4,851	Wellington	4,245
Iola	5,791	Wichita	24,671
Junction	4,695	Winfield	5,554
Kansas City	51,418	Yates Center	1,634

Kansas City, Mo., p. 163,752.—Kans., p. 51,418.
Kansu, prov., China, □ 131,000, p. 9,285,000.
Karachi, city, India, p. 115,407.
Karlsruhe, city, Baden, Germany, p. 84,030.
Kashmir, state, India, □ 80,000, p. 2,906,173.
Kassel, city, Prussia, p. 106,928.
Katmandu, * Nepal, p. 50,000.
Kazan, city, Russia, p. 131,508.
Kecskemet, city, Hungary, p. 56,951.
Keewatin, ter., Canada, □ 756,000.
Kena, city, Egypt, p. [illegible].
Kent, co., England, □ 1,555, p. 1,056,063.
Kentucky, So. central state, □ 40,400, p. 2,147,174, * Frankfort.
Incorporated cities and towns of 1,000 pop. or more in 1900:

Ashland	6,800	Lawrenceburg	1,553
Augusta	1,773	Lebanon	3,043
Barbourville	1,909	Lexington	26,369
Bardstown	1,711	London	1,147
Bardwell	1,512	Louisa	1,086
Bellevue	6,332	Louisville	204,731
Bowling Gr'n	8,226	Ludlow	3,334
Campbellsv'le	1,341	Madisonville	3,628
Carlisle	1,577	Marion	1,064
Carrollton	2,396	Mayfield	4,081
Catlettsburg	3,081	Maysville	6,423
Central City	1,345	Middleboro	4,162
C'n'l Cov'gt'n	2,155	Midway	1,045
Clinton	1,462	Morehead	1,100
Cloverport	1,656	Morgantown	2,046
Columbus	1,225	Mt. Sterling	3,561
Corbin	1,544	Mt. Wash'gt'n	1,093
Covington	42,938	Murray	1,822
Cynthiana	3,257	Newport	28,301
Danville	4,285	Nicholasville	2,393
Dayton	6,104	Owensboro	13,189
Earlington	3,012	Owenton	1,014
Eddyville	1,210	Paducah	19,446
Elizabethtown	1,961	Paris	4,603
Elkton	1,123	Pineville	2,072
Eminence	1,018	Princeton	2,556
Falmouth	1,134	Providence	1,286
Flemingsburg	1,268	Richmond	4,653
Frankfort	9,487	Russellville	2,591
Franklin	2,166	Sebree	1,477
Fulton	2,560	Shelbyville	3,016
Georgetown	3,823	Somerset	3,384
Glasgow	2,019	Springfield	1,016
Greenville	1,051	Stanford	1,651
Harrodsburg	2,876	Sturgis	1,258
Hawesville	1,041	Uniontown	1,532
Henderson	10,272	Vanceburg	1,161
Hickman	1,589	Versailles	2,337
Hopkinsville	7,280	West Cov'gt'n	1,606
Lancaster	1,640	Williamsburg	1,495
Latonia	1,882	Winchester	5,964

Kerbela, city, Mesopotamia, Asia, p. 65,000.
Kerman, city, Persia, p. 45,000.
Kharkov, city, Russia, p. 174,846.
Khartum, * Egyptian Sudan.
Kherson, city, Russia, p. 69,219.
Khiva, Rus. vassal state, Asia, □ 22,320 p. 800,000, * Khiva, p. 5,000.
Khurdistan, see Armenia.
Kiangsi, prov. China, □ 67,500, p. 24,534,000.
Kiangsu, prov. China, □ 36,900, p. 20,905,000.
Kiau-Chau, district of Shan-Tung, China, seized by Germany in 1897, □ 200, p. 60,000.
Kiel, city, Prussia, p. 107,938.
Kiev, city, Russia, p. 247,432.
Kilmarnock, town, Scotland, p. 34,161.
Kimberley, city, Cape Colony, p. 28,718.
Kingston, * Jamaica, p. 46,542.
Kingston-upon-Hull, city, England, p. 240,618.
Kio'to, city, Japan, p. 353,139.
Kirkcaldy, town, Scotland, p. 34,064.
Kishinev, city, Russia, p. 108,796.
Kiukiang, city, China, on Yangtse R., p. 55,000.
Knoxville, Tenn., p. 32,637.
Kobe, city, Japan, p. 215,780.
Kokand, city, Rus. Turkestan, p. 82,054.
Kongo Free State, same as Congo.
Koniah, city, Asia Minor, p. 44,000.
Konigsberg, city, Prussia, p. 187,897.
Korea, kingdom of E. Asia, □ 82,000, p. est. 10,000,000, * Seoul, p. 201,000.
Kovno, city, Russia, p. 73,543.
Krakau, see Cracow.
Krefeld, city, Prussia, p. 106,928.
Kremenchug, city, Russia, p. 58,648.
Kumamoto, city, Japan, p. 61,463.
Kuria Muria, five islands off So. coast Arabia (British).

Kursk, city, Russia, p. 52,896.
Kwangsi, prov. China, □ 80,100, p. 5,181,000.
Kwangtung, prov. China (with Hainan Isl.), □ 79,456, p. 29,706,000.
Kwang-Tung, prov. of E. China, leased to Russia in 1898 for 25 years, • Port Arthur.
Kweichau, prov. China, □ 58,000, p. 7,669,000.

L

Labrador, ter. on coast No. of Newfoundland, dep. of Newfoundland, □ 120,000, p. 3,634.
Labuan', isl. No. of Borneo, British crown colony, □ 30, p. 5,853, • Victoria, p. 1,500.
La Crosse, Wis., p. 28,895.
Lagos, Brit. W. Africa, crown colony, □ 985, p. 85,607. — Also Protectorate, □ 21,000, p. 3,000,000.
Lahore', city, India, p. 120,058.
Lancaster, Pa., p. 41,459.—co. Eng., □ 1,757, p. 1,827,390.
La'os, Fr. Posses. Indo China, □ 91,000, p. 1,500,000, • Luang Prabang.
La Paz, city, Bolivia, p. 62,320.
La Plata, city, Argentine Republic, p. 45,410.
Las Palmas, city, Spain, p. 34,770.
Lausanne', city, Switzerland, p. 55,973.
Lawrence, Mass., p. 62,559.
Lebanon, privileged prov. Syria, □ 2,509, p. 399,500.
Lecce, city, Italy, p. 33,118.
Le Creusot, city, France, p. 32,034.
Leeds, city, Eng., p. 428,953.
Leeward Islands, British West Indies, S. E. of Porto Rico, □ 701, p. 127,723, • St. John, Antigua Isl., p. 9,738.
Leghorn, city, Italy, p. 105,767.
Le Havre, city, France, p. 129,000.
Leicester (les'ter), co. Eng., □ 813, p. 225,-896.—Its • p. 211,574.
Leiden, city, Holland, p. 53,640.
Leignitz, city, Prussia, p. 51,518.
Leinster, prov. Ireland (inc. Carlow, Dublin, Kildare, Kilkenny, King's, Longford, Louth, Meath, Queen's, Westmeath, Wexford and Wicklow counties), □ 7,622, p. 1,150,485.
Leipsic (Leipzig), • Saxony, Germany, p. 455,089.
Leith, city, Scotland, p. 76,667.
Le Mans, city, France, p. 69,075.
Lemberg, city, Austria, p. 159,618.
Leon, city, Mexico, p. 58,426. — city, Nicaragua, p. 35,000.
Levallois-Perret, city, France, p. 47,315.
Lexington, Ky., p. 26,369.
Leyte, isl., Philippines, □ 3,800.
Libau, city, Russia, p. 64,505.
Liberia, Negro republic, W. Africa, □ 25,000, p. 2,060,000.
Liechtenstein, principality on Rhine R., □ 65, p. 9,434, • Vaduz.
Liege, city, Belgium, p. 171,031.
Lille, city, France, p. 215,400.
Lima, • Peru, p. 100,000.
Limerick, city, Ireland, p. 38,085.
Limoges (le-mozh'), city, France, p. 77,703.
Linares, city, Spain, p. 35,233.
Lincoln, • Neb., p. 40,169. — co., Eng. (inc. Holland, Kesteven and Lindsay), □ 2,638, p. 388,038. — its • p. 48,784.
Linz, city, Austria, p. 47,560.
Lippe, Ger. principality, □ 469, p. 139,238. • Detmold, p. 11,232.
Lisbon, • Portugal, p. 301,206.
Little Rock, • Ark., p. 38,307.
Liverpool, city, Eng., p. 684,947.
Lodz, city, Poland, Russia, p. 315,209.
London, • England and British Empire, and administrative county, □ 118, p. 4,536,063. — city, Canada, p. 37,983.
Londonderry, city, Ireland, p. 39,873.
Lorca, city, Spain, p. 59,624.
Lorient, city, France, p. 41,894.
Los Angeles, Cal., p. 102,479.
Louisiana, So. Central state, □ 48,720, p. 1,381,625, • Baton Rouge.
Incorporated cities and towns of 1,000 pop. or more in 1900:

Louisiana.—Continued.

Abbeville	1,536	Mandeville	1,029
Alexandria	5,648	Minden	1,561
Amite	1,547	Monroe	5,428
Baton Rouge	11,269	Morgan	2,332
Covington	1,205	Natchitoches	2,388
Crowley	4,214	New Iberia	6,815
Donaldsonv'le	4,105	New Orleans	287,104
Franklin	2,692	Opelousas	2,951
Hammond	1,511	Plaquemine	3,590
Homer	1,157	Rayne	1,007
Houma	3,212	Ruston	1,324
Jackson	2,012	St. Francisv'le	1,059
Jeanerette	1,905	St. Martinsv'le	1,926
Jennings	1,539	Shreveport	16,013
Kenner	1,253	Slidell	1,129
Kentwood	1,313	Thibodaux	3,253
Lafayette	3,314	Vidalia	1,022
Lake Charles	6,680	Washington	1,197
L'ke Provid'ce	1,256	White Castle	1,850
Leesville	1,148		

Louisville, Ky., p. 204,731.
Louvain, city, Belgium, p. 42,100.
Lowell, Mass., p. 94,969.
Lower Austria, prov., Austria, □ 7,654, p. 3,086,382.
Lower California, ter. Mex., □ 58,328, p. 41,838.
Lubeck, German Free city, □ 115, p. 96,775, p. city proper, 69,874.
Lublin, city, Poland Russia, p. 50,152.
Lucca, city, Italy, p. 81,644.
Lucerne', city, Switzerland, p. 29,145.
Lucknow, city, India, p. 263,951.
Ludwigshafen, city, Bavaria, Germany, p. 39,799.
Luxemburg, grand duchy, E. of Belgium, □ 998, p. 217,583, • Luxemburg, p. 19,909.
Luzon', largest isl. of Philippines, □ 44,000.
Lynn, Mass., p. 68,513.
Lyon, city, France, p. 453,100.

M

Macao, Portuguese col., isl., mouth of Canton R., China, □ 4, p. 78,627. — city on isl.
McKeesport, Pa., p. 34,227.
Mackenzie, ter., Canada, □ 198,300.
Madagascar, isl., E. of So. Africa, Fr. Protectorate, □ 227,750, p. 2,250,000, • Antananarivo, p. 260,000.
Madras, prov. British India, □ 141,189, p. 38,208,609, • Madras, p. 509,397.
Madras States, British India, □ 9,891, p. 4,190,322.
Madrid, • Spain, p. 512,150.
Madura, city, India, p. 105,501.
Magdeburg, city, Prussia, p. 229,663.
Maine, N. Atlantic state, □ 33,040, p. 694,466, • Augusta.
Incorporated cities and towns of 1,000 or more in 1900:

Auburn	12,951	Hallowell	2,714
Augusta	11,683	Lewiston	23,761
Bangor	21,850	Madison	1,850
Bath	10,477	Norway	2,034
Belfast	4,615	Old Town	5,763
Biddeford	16,145	Pittsfield	2,208
Brewer	4,835	Portland	50,145
Bridgton	1,552	Presque Isle	1,256
Brunswick	5,210	Rockland	8,150
Calais	7,655	Rumford Falls	2,595
Eastport	5,311	Saco	6,122
Ellsworth	4,297	Skowhegan	4,266
Fairfield	2,238	South Paris	1,457
Farmington	1,251	So. Portland	6,287
Fort Fairfield	1,469	Waterville	9,477
Gardiner	5,501	Westbrook	7,283

Mainz (Mayence), city, Hesse, Germany, p. 76,946.
Malaga, city, Spain, p. 125,579.
Malden, Mass., p. 33,664.
Maldive Islands, 17 coral islets, 500 mi. W. of Ceylon (British), p. 30,000.
Malmo, city, Sweden, p. 59,714.
Malta, isl. in Mediterranean (British), □ 95, p. 181,648, • Valetta.
Managua, • Nicaragua, p. 25,000.

Manchester, N. H., p. 56,987. — city, Eng., p. 543,969.
Manchuria, depend., Chinese Empire, □ 362,-310, p. 7,500,000, * Tsitsihar.
Mandalay, city, India, p. 182,498.
Manila, * Philippine Isls., p. 350,000.
Manitoba, prov., Canada, □ 73,956, p. 246,464, * Winnipeg.
Mannheim, * Baden, Germany, p. 140,384.
Mansou'rah, city, Egypt, p. 36,131.
Mantua, city, Italy, p. 30,217.
Maracai'bo, city, Venezuela, p. 34,284.
Maranha'o, city, Brazil, p. 29,308.
Marianne (or Ladrone) **Islands**, group in No. Pacific, belong to Germany except Guam (U. S.).
Marseilles, city, France, p. 494,800.
Marshall Islands, group in No. Pacific, belong to Germany, □ 150, p. 15,000.
Martinique, Fr., island colony in West Indies, □ 381, p. 187,692, * Fort de France.
Maryland, So. Atlantic state, □ 12,210, p. 1,188,044, * Annapolis.
Incorporated cities and towns of 1,000 pop. or more in 1900:

Annapolis	8,525	Havre de Grace	3,423
Baltimore	508,957	Hyattsville	1,222
Berlin	1,246	Laurel	2,079
Brunswick	2,471	Lonaconing	2,181
Cambridge	5,747	Oakland	1,170
Centerville	1,231	Oxford	1,243
Chesapeake	1,172	Pocomoke City	2,124
Chestertown	3,008	Fort Deposit	1,575
Crisfield	3,165	Rockville	1,110
Cumberland	17,128	St. Michaels	1,043
Easton	3,074	Salisbury	4,277
Elkton	2,542	Sharpsburg	1,030
Ellicott City	1,331	Snow Hill	1,596
Frederick	9,296	Westerport	1,998
Frostburg	5,274	Westminister	3,199
Hagerstown	13,591	Williamsport	1,472

Masba'te, isl., Philippines, □ 1,400.
Mashonaland, pt. of So. Rhodesia, So. Africa, British, □ 92,000, p. 305,000, * Salisbury.
Massa, city, Italy, p. 26,897.
Massachusetts, No. Atlantic state, □ 8,315, p. 2,805,346, * Boston.
Incorporated cities and towns of 1,000 pop. or more in 1900:

Beverly	13,884	Medford	18,244
Boston	560,892	Melrose	12,962
Brockton	40,063	New Bedford	62,442
Cambridge	91,886	Newburyport	14,478
Chelsea	34,072	Newton	33,587
Chicopee	19,167	North Adams	24,200
Everett	24,336	Northamton	18,643
Fall River	104,863	Pittsfield	21,766
Fitchburg	31,531	Quincy	23,899
Gloucester	26,121	Salem	35,956
Haverhill	37,175	Somerville	61,643
Holyoke	45,712	Springfield	62,059
Lawrence	62,559	Taunton	31,036
Lowell	94,969	Waltham	23,481
Lynn	68,513	Woburn	14,254
Malden	33,664	Worcester	118,421
Marlboro	13,609		

Matabeleland, pt. of So. Rhodesia, So. Africa, British, □ 100,000, p. 156,835, * Salisbury.
Matanzas, city, Cuba, p. 36,375.
Mauritius, isl., in Indian Ocean, British Colony, □ 705, p. 371,655.
Mayotte', isl. on E. coast of Africa, belongs to France, □ 140, p. 11,640.
Mecca, * Hedjaz, Arabia, p. 60,000.
Mechlin, city, Belgium, p. 55,530.
Mecklenburg-Strelitz, Ger. grand-duchy, □ 1,131, p. 102,628, * Neu Strelitz, p. 10,343.
Mecklenburg-Schwerin, Ger. grand-duchy, □ 5,135, p. 607,835, * Schwerin.
Medellin, city, Colombia, p. 40,000.
Medineh (or Medina), city, Arabia, p. 48,000.
Meerut, city, India, p. 116,642.
Meiningen, * Saxe-Meiningen, Germany, p. 12,869.
Melbourne, * Victoria, Australia, p. 494,129.
Memphis, Tenn., p. 102,320.
Mendoza, city, Argentine Rep., p. 28,708.
Mer'ida, city, Mexico, p. 36,935.
Merioneth, co., Wales, □ 668, p. 48,774.
Meshed, city, Persia, p. 60,000.
Mesopotamia, Turkish prov., Asia, □ 100,305, p. 1,350,300.
Messina, city, Italy, p. 156,552.
Metz, city, Alsace-Lorraine, Germany, p. 59,794.
Mexico, Am. Republic, □ 767,005, p. 13,545,462, * Mexico, p. 368,777. — state, Mexico, □ 9,247, p. 837,981.
Michigan, No. Central state, □ 58,915, p. 2,420,982, * Lansing.
Incorporated cities and towns of 1,000 pop. or more in 1900:

Adrian	9,654	Howard City	1,398
Albion	4,519	Howell	2,518
Algonac	1,216	Hudson	2,405
Allegan	2,667	Imlay City	1,122
Alma	2,047	Ionia	5,209
Alpena	11,802	Iron Mountain	9,242
Ann Arbor	14,509	Iron River	1,482
Au Sable	1,116	Ironwood	9,705
Baldwin	1,241	Ishpeming	13,255
Bangor	1,021	Ithaca	2,020
Baraga	1,185	Jackson	25,180
Battle Creek	18,563	Jonesville	1,367
Bay City	27,628	Kalamazoo	24,404
Belding	3,232	Kalkaska	1,304
Bellaire	1,157	Lake Linden	2,597
Bellevue	1,074	Lake Odessa	1,037
Benton H'bor	6,562	Lansing	16,485
Bessemer	3,911	Lapeer	3,297
Big Rapids	4,686	Laurium	5,643
Birmingham	1,170	Leslie	1,114
Blissfield	1,268	Lowell	1,736
Bronson	1,176	Ludington	7,166
Buchanan	1,708	Mancelona	1,226
Cadillac	5,997	Manchester	1,209
Caro	2,006	Manistee	14,260
Cass City	1,113	Manistique	4,126
Cassopolis	1,330	Marcellus	1,025
Central Lake	1,307	Marine City	3,829
Charlevoix	2,079	Marquette	10,058
Charlotte	4,092	Marshall	4,370
Cheboygan	6,489	Mason	1,828
Chelsea	1,635	Menominee	12,818
Chesaning	1,244	Midland	2,363
Clare	1,326	Milan	1,141
Clinton	1,038	Milford	1,108
Coldwater	6,216	Monroe	5,043
Coleman	1,014	Morenci	1,334
Constantine	1,226	Mt. Clemens	6,576
Corunna	1,510	Mt. Pleasant	3,662
Crystal Falls	3,231	Munising	2,014
Decatur	1,356	Muskegon	20,818
Delray	4,573	Muskegon Heights	1,012
Detroit	285,704	Nashville	1,164
Dowagiac	4,151	Negaunee	6,935
Dundee	1,118	Newaygo	1,172
Durand	2,134	Newberry	1,015
East Jordan	1,205	Niles	4,287
East Tawas	1,736	Northville	1,755
Eaton Rapids	2,103	Norway	4,170
Escanaba	9,549	Onaway	1,204
Essexville	1,639	Ontonagon	1,267
Evart	1,360	Oscoda	1,109
Fenton	2,408	Otsego	2,073
Flint	13,103	Ovid	1,293
Frankfort	1,465	Owosso	8,696
Fremont	1,331	Oxford	1,172
Gaylord	1,561	Paw Paw	1,465
Gladstone	3,380	Pentwater	1,061
Grand Haven	4,743	Petoskey	5,285
Grand Ledge	2,161	Plainwell	1,318
Grand Rapids	87,565	Plymouth	1,474
Greenville	3,381	Pontiac	9,769
Hancock	4,050	Port Huron	19,158
Harbor Beach	1,149	Portland	1,874
Harbor Springs	1,643	Quincy	1,563
Hart	1,134	Reading	1,096
Hartford	1,077	Red Jacket	4,668
Hastings	3,172	Reed City	2,051
Hillsdale	4,151	Richmond	1,133
Holland	7,790	River Rouge	1,748
Holly	1,419	Rochester	1,535
Homer	1,097	Romeo	1,580
Houghton	3,359	Saginaw	42,345

Michigan.—Continued.

- St. Charles....1,317
- St. Clair.......2,543
- St. Ignace.....2,271
- St. Johns......3,388
- St. Joseph.....5,155
- St. Louis......1,989
- Sault Ste. Marie 10,538
- Sebewaing 1,243
- Shelby 1,081
- South Haven..4,009
- Sparta 1,126
- Stanton 1,234
- Sturgis 2,465
- Tawas 1,228
- Tecumseh 2,400
- Three Rivers..3,550
- Traverse City.9,407
- Trenton 1,167
- Union City....1,514
- Vassar 1,832
- Wakefield 1,191
- Wayne 1,361
- West Bay City 13,119
- West Branch..1,412
- Whitehall 1,481
- Williamston ..1,113
- Wyandotte ...5,183
- Yale 1,125
- Ypsilanti 7,378
- Zeeland 1,326

Michoacan', state, Mexico, □ 22,874, p. 887,008.
Middlesex, co., Eng., □ 233, p. 792,225.
Middlesbrough, town, Eng., p. 91,317.
Milan, city, Italy, p. 492,162.
Milwaukee, Wis., p. 285,315.
Mindana'o, second largest of Philippine Isls., □ 57,500.
Mindo'ro, isl., Philippines, □ 4,000.
Minneapolis, Minn., p. 202,718.
Minnesota, No. central state, □ 83,365, p. 1,751,394, * St. Paul.

Incorporated cities and towns of 1,000 pop. or more in 1900:

- Ada 1,253
- Adrian 1,258
- Aitkin 1,719
- Albert Lea....4,500
- Alexandria ...2,681
- Anoka 3,769
- Appleton 1,184
- Austin 5,474
- Barnesville ...1,326
- Belle Plaine...1,121
- Bemidji 2,183
- Benson 1,525
- Biwabik 1,299
- Blue Earth....2,900
- Brainerd 7,524
- Breckenridge 1,282
- Buffalo 1,040
- Caledonia 1,175
- Canby 1,100
- Cannon Falls 1,239
- Chaska 2,165
- Chatfield 1,426
- Cloquet 3,072
- Crookston 5,359
- Detroit 2,060
- Duluth 52,969
- East Grand Forks 2,077
- Ely 3,717
- Eveleth 2,752
- Fairmont 3,040
- Faribault 7,868
- Fergus Falls..6,072
- Frazee 1,000
- Glencoe 1,780
- Glenwood 1,116
- Grand Rapids 1,428
- Granite Falls.1,214
- Hastings 3,811
- Hibbing 2,481
- Hutchinson ..2,495
- Jackson 1,756
- Janesville.....1,254
- Jordan 1,270
- Kasson 1,112
- Kenyon 1,202
- Lake City.....2,744
- Lake Crystal.1,215
- Lanesboro 1,102
- Lesueur 1,937
- Litchfield 2,280
- Little Falls...5,774
- Long Prairie..1,385
- Luverne 2,223
- Madelia 1,272
- Madison 1,336
- Mankato 10,599
- Mapleton 1,008
- Marshall 2,088
- Melrose 1,768
- Milaca 1,204
- Minneapolis 202,718
- Montevideo ...2,146
- Moorhead 3,730
- Morris 1,934
- New Prague...1,228
- New Ulm......5,403
- North Branch 1,211
- Northfield 3,210
- No. St. Paul..1,110
- Ortonville 1,247
- Owatonna 5,561
- Park Rapids..1,313
- Pelican Rapids 1,033
- Perham 1,182
- Pipestone 2,536
- Plainview 1,038
- Preston 1,278
- Princeton 1,319
- Red Lake Falls 1,885
- Red Wing.....7,525
- RedwoodFalls 1,661
- Renville 1,075
- Rochester 6,843
- Rushford 1,062
- St. Charles....1,304
- St. Cloud......8,663
- St. James.....2,607
- St. Louis Park 1,325
- St. Paul.....163,065
- St. Peter......4,302
- Sandstone 1,189
- Sauk Center..2,220
- Sauk Rapids..1,391
- Shakopee 2,047
- Sleepy Eye...2,046
- So. St. Paul..2,322
- So. Stillwater 1,422
- Springfield ...1,511
- Spring Valley 1,770
- Staples 1,504
- Stillwater ...12,318
- Thief River Falls 1,819
- Tower 1,366
- Tracy 1,911
- Two Harbors.3,278
- Virginia 2,962
- Wabasha 2,528
- Wadena 1,520
- Warren 1,276
- Waseca 3,103
- Waterville 1,260
- Wells 2,017

Minnesota.—Continued.

- West Minneapolis 1,648
- West St. Paul.1,830
- Wheaton 1,132
- White Bear Lake 1,288
- Willmar 3,409
- Windom 1,944
- Winnebago City 1,816
- Winona 19,714
- Worthington .2,386
- Zumbrota 1,119

Minsk, city, Russia, p. 91,494.
Mirza'pur, city, India, p. 79,787.
Mississippi, So. central state, □ 46,810, p. 1,551,270, * Jackson.

Incorporated cities and towns of 1,000 pop. or more in 1900:

- Aberdeen 3,434
- Amory 1,211
- Bay St. Louis.2,872
- Biloxi 5,467
- Booneville ...1,050
- Brookhaven ..2,678
- Canton 3,404
- Clarksdale 1,773
- Columbus 6,484
- Corinth 3,661
- Crystal Spgs..1,093
- Durant 1,766
- Ellisville 1,899
- Fostoria 1,422
- Gloster 1,661
- Greenville 7,642
- Greenwood ...3,026
- Grenada 2,568
- Gulfport 1,060
- Hattiesburg ..4,175
- Hazlehurst ...1,579
- Holly Springs.2,815
- Jackson 7,816
- Kosciusko 2,078
- Laurel 3,193
- Lexington 1,516
- Lumberton ...1,509
- McComb 4,477
- Macon 2,057
- Magnolia 1,038
- Meridian 14,050
- Natchez 12,210
- New Albany..1,033
- Ocean Springs 1,255
- Okolona 2,177
- Oxford 1,825
- Pass Christian 2,028
- Pontotoc 1,010
- Port Gibson...2,113
- Sardis 1,002
- Scranton 2,025
- Senatobia 1,156
- Starkville 1,986
- Summit 1,499
- Tupelo 2,118
- Vicksburg ...14,834
- Water Valley.3,813
- Wesson 3,279
- West Point....3,193
- Winona 2,455
- Woodville 1,043
- Yazoo 4,944

Missouri, No. central state, □ 69,415, p. 3,106,665, * Jefferson City.

Incorporated cities and towns of 1,000 pop. or more in 1900:

- Albany 2,025
- Appleton City.1,133
- Ash Grove....1,039
- Aurora 6,191
- Belton 1,005
- Bethany 2,093
- Bevier 1,808
- Bloomfield ...1,475
- Bolivar 1,869
- Boonville 4,377
- BowlingGreen 1,902
- Breckenridge 1,012
- Brookfield 5,484
- Brunswick 1,403
- Butler 3,158
- California 2,181
- Cameron 2,979
- Canton 2,365
- Cape Girardeau ..4,815
- Carl Junction.1,177
- Carrollton 3,854
- Carterville ...4,445
- Carthage 9,416
- Caruthersville 2,315
- Centralia 1,722
- Charleston ...1,893
- Chillicothe ...6,905
- Clarence 1,184
- Clinton 5,061
- Columbia 5,651
- Deepwater 1,201
- De Soto.......5,611
- Dexter 1,862
- Doniphan 1,508
- Edina 1,605
- Eldorado Spgs 2,137
- Excelsior Spgs 1,881
- Farmington ..1,778
- Fayette 2,717
- Ferguson 1,015
- Festus 1,256
- Fredericktown 1,577
- Fulton 4,883
- Gallatin 1,780
- Glasgow 1,672
- Granby 2,315
- Grant City....1,406
- Greenfield 1,406
- Greenville 1,051
- Hamilton 1,804
- Hannibal 12,780
- Harrisonville 1,844
- Hermann 1,575
- Higbee 1,151
- Higginsville.. 2,791
- Holden 2,126
- Humansville. 1,055
- Huntsville ...1,805
- Independence 6,974
- Jackson (Cape Girardeau Co.) 1,658
- Jefferson City 9,664
- Joplin 26,023
- Kahoka 1,818
- Kansas City 163,752
- Kennett 1,509
- Keytesville ...1,127
- Kirksville 5,966
- Kirkwood 2,825
- La Grange....1,507
- Lamar 2,737
- La Plata.......1,345
- Lathrop 1,118
- Lebanon 2,125
- Lees Summit.1,453
- Lexington 4,190
- Liberty 2,407
- Louisiana 5,131
- Macon 4,068
- Malden 1,462
- Marceline 2,638
- Marionville ..1,290
- Marshall 5,086
- Maryville 4,577

Missouri.—Continued.

Memphis 2,195
Mexico 5,099
Milan 1,757
Moberly 8,012
Monett 3,115
Monroe City..1,929
Montgomery City 2,026
Mound City...1,681
Mountain Grove 1,004
Mt. Vernon...1,206
Neosho 2,725
Nevada 7,461
New Franklin.1,156
New Madrid..1,489
Norborne 1,189
Odessa 1,445
Oregon 1,032
Oronogo 2,073
Osceola 1,037
Pacific 1,213
Palmyra 2,323
Paris 1,397
Pattonsburg ..1,065
Perryville 1,275
Pierce City....2,151
Plattsburg 1,878
Pleasant Hill.2,002
Poplar Bluff..4,321
Princeton 1,575
Rich Hill.....4,053
Richmond 3,478
Rockport 1,080
Rolla 1,600
St. Charles....7,982
St. Genevieve.1,707
St. Joseph...102,979
St. Louis....575,238
Salem 1,481
Salisbury 1,847
Sarcoxie 1,126
Savannah 1,886
Sedalia 15,231
Seneca 1,043
Shelbina 1,733
Sikeston 1,077
Slater 2,502
Springfield ..23,267
Stanberry 2,654
Sweet Springs 1,080
Tarkio 1,901
Thayer 1,276
Tipton 1,337
Trenton 5,396
Troy 1,153
Unionville 2,050
Vandalia 1,168
Versailles 1,240
Warrensburg 4,724
Washington ..3,015
Webb City....9,201
Webster Groves 1,895
Wellsville 1,160
Weston 1,019
West Plains...2,902
Willow Spgs..1,078
Windsor 1,502

Mobile, Ala., p. 38,469.
Modena, city, Italy, p. 68,195.
Molucca Islands, Dutch E. Indies, □ 43,864, p. 399,208.
Monaco, principality on Mediterranean, □ 8, p. 13,304; towns: Monaco, Condamine, Monte Carlo.
Mongolia, depend. Chinese Empire, □ 1,288,-000, p. 2,000,000.
Monlucon, city, France, p. 31,595.
Monmouth, co., Eng., □ 535, p. 230,800.
Mons, city, Belgium, p. 25,599.
Montana, Western state, □ 146,080, p. 243,329, * Helena.

Incorporated cities and towns of 1,000 pop. or more in 1900:

Anaconda 9,453
Billings 3,221
Bozeman 3,419
Butte 30,470
Deerlodge 1,324
Dillon 1,530
Fort Benton...1,024
Great Falls..14,930
Hamilton 1,257
Havre 1,033
Helena 10,770
Kalispel 2,526
Lewistown ...1,096
Livingston ...2,778
Miles City.....1,938
Missoula 4,366
Red Lodge....2,152
Walkerville . 2,621

Montene'gro, ind. principality, Balkan pen., Europe, □ 3,630, p. 228,000, * Cettinje, p. 2,920.
Monterey', city, Mexico, p. 62,266.
Montevideo, * Uruguay, p. 266,000.
Montgomery, Ala., p. 30,346. — co., Wales, □ 797, p. 54,892.
Montpellier, city, France, p. 73,931.
Montreal, * prov. Quebec, Canada, p. 266,826.
Moradabad, city, India, p. 75,176.
Moravia, prov. Austria, □ 8,583, p. 2,435,081.
More'los, state, Mex., □ 2,773, p. 156,786.
Morelia, city Mexico, p. 33,890.
Morocco, empire, N. E. Africa, □ 219,000, p. (est.) 5,000,000, * Fez.
Moscow, city, Russia, p. 988,614.
Mosul, city, Mesopotamia, Asia, p. 61,000.
Motherwell, town, Scotland, p. 20,423.
Mulhauser, city, Alsace-Lorraine, Germany, p. 82,986.
Munchen Gladbach, city, Prussia, p. 53,662.
Munich, * Bavaria, Germany, p. 499,959.
Munster, prov. Ireland (inc. Clare, Cork, Kerry, Limerick, Tipperary and Waterford counties), □ 9,481, p. 1,075,075.
Munster, *city*, Prussia, p. 57,135.
Murcia, *city*, *Spain*, *p.* 108,408.
Muscat, * Oman, p. 40,000.
Muttra, city, India, p. 59,574.
Mysore (sor'), state, India, □ 27,936, p. 5,-538,482. — its * p. 68,151.

N

Nagasa'ki, city, Japan, p. 107,422.
Nagoy'a, city, Japan, p. 244,145.
Nagpur', city, India, p. 124,599.
Namangan', city, Rus. Turkestan, p. 61,906.
Na'mur, city, Belgium, p. 32,110.
Nancy, city, France, p. 102,500.
Nanking, city, China, on Yangtse R., p. 250,-000.
Nantes, city, France, p. 128,300.
Naples, city, Italy, p. 544,057.
Nashville, * Tenn., p. 80,865.
Natal, So. Africa, So. of Transvaal, British colony, inc. prov. of Zululand, □ 35,019, p. 902,365, * Pietermaritzburg, p. 24,595.
Nebraska, No. central state, □ 77,510, p. 1,066,300, * Lincoln.

Incorporated cities and towns of 1,000 pop. or more in 1900:

Albion 1,369
Alliance 2,535
Ashland 1,477
Auburn 2,664
Aurora 1,921
Beatrice 7,875
Blair 2,970
Broken Bow...1,375
Central City..1,571
Chadron 1,665
Columbus 3,522
Crete 2,199
David City....1,845
Edgar 1,040
Fairbury 3,140
Fairfield 1,203
Falls City.....3,022
Fremont 7,241
Friend 1,200
Fullerton 1,464
Geneva 1,534
Grand Island..7,554
Hastings 7,188
Havelock 1,480
Hebron 1,511
Holdrege 3,007
Humboldt 1,218
Kearney 5,634
Lexington 1,343
Lincoln 40,169
McCook 2,445
Madison 1,47
Minden 1,238
Nebraska City 7,380
Neligh 1,135
Norfolk 3,883
North Bend...1,010
North Platte..3,640
Oakland 1,008
Omaha 102,555
O'Neill 1,107
Ord 1,372
Pawnee 1,969
Plattsmouth ..4,964
Ponca 1,043
Red Cloud....1,554
St. Paul.......1,475
Schuyler 2,157
Seward 1,970
Sidney 1,001
South Omaha 26,001
Stanton 1,052
Stromsburg ...1,154
Superior 1,577
Sutton 1,365
Tecumseh 2,005
Tekamah 1,597
University Place 1,130
Wahoo 2,100
Wayne 2,119
Weeping Water 1,156
West Point....1,890
Wilber 1,054
Wymore 2,626
York 5,132

Negapatam, city, India, p. 56,455.
Negros, isl., Philippines, □ 3,300.
Nepal, kingdom in the Himalayas, Asia, □ 54,000, p. (est.) 5,000,000, * Katmandu, p. 50,000.
Netherlands, The (Holland), kingdom, W. Europe, □ 12,648, p. 5,103,924, * The Hague.
Neuilly, city, France, p. 32,730.
Nevada, Western state, □ 110,700, p. 42,335, * Carson City.

Incorporated cities and towns of 1,000 pop. or more in 1900:

Carson City...2,100
Reno 4,500
Virginia City..2,695

Newark, N. J., p. 246,070.
New Bedford, Mass., p. 62,442.
New Britain, Conn., p. 25,998.
New Brunswick, prov. Canada, □ 28,200, p. 331,093, * Fredericton.
New Caledonia, isl., So. Pacific, Fr. pénal colony, □ 6,000, p. 52,756, * Noumea.
Newcastle, Pa., p. 28,339.
Newcastle-upon-Tyne, city, Eng., 214,803.
Newfoundland, isl. G. of St. Lawrence, British, □ 42,200, p. 216,615, * St. John's, p. 29,007.

New Guinea, isl. E. Indies, belongs to Gr. Britain, Holland and Germany, □ 300,000, p. 813,000.

New Hampshire, No. Atlantic state, □ 9,305, p. 411,588, * Concord.
Incorporated cities and towns of 1,000 pop. or more in 1900:

Berlin 8,886
Concord 19,632
Dover 13,207
Franklin 5,846
Keene 9,165
Laconia 8,042
Manchester ..56,987
Nashua 23,898
Portsmouth. 10,637
Rochester 8,466
Somersworth .7,023

New Haven, Conn., p. 108,027.

New Jersey, No. Atlantic state, □ 7,185, p. 1,883,669, * Trenton.
Incorporated cities and towns of 1,000 pop. or more in 1900:

Asbury Park..4,148
Atlantic City 27,838
Atlantic Highlands ..1,383
Bayonne 32,722
Belvidere 1,784
Beverly 1,950
Bloomfield 9,668
Boonton 3,901
Bordentown ..4,110
Boundbrook ..2,622
Bridgeton ...13,913
Burlington ...7,392
Caldwell 1,367
Camden 75,935
Cape May.....2,257
Carlstadt 2,574
Chatham 1,361
Clayton 1,951
Collingswood. 1,633
Deckertown ..1,306
Dover 5,938
Dunellen 1,239
East Newark..2,500
East Orange..21,506
E. Rutherford 2,640
Egg Harbor...1,808
Elizabeth 52,130
Elmer 1,140
Englewood ...6,253
Fairview 1,003
Flemington ...2,145
Freehold 2,934
Frenchtown ..1,020
Garfield 3,504
Glen Ridge....1,960
Gloucester City 6,840
Guttenberg ...3,825
Hackensack ..9,443
Hackettstown 2,474
Haddonfield ..2,776
Hammonton ..3,481
Harrison 10,596
Hasbrouck Heights 1,255
Hawthorne ...2,096
High Bridge..1,377
Highlands 1,228
Hightstown ..1,749
Hoboken 59,364
Irvington 5,255
Jamesburg ...1,063
Jersey City..206,433
Kearney 10,896
Keyport 3,413
Lambertville .4,637
Little Ferry...1,240
Lodi 1,917
Long Branch.8,872
Madison 3,754
Manasquan ...1,500
Matawan 1,511
Merchantville 1,608
Metuchen 1,786
Midland Park.1,348
Millville 10,583
Montclair 13,962
Morristown .11,267
Neptune City.1,009
Newark 246,070
New Brunswick 20,006
Newton 4,376
No. Plainfield 5,009
Ocean City....1,307
Orange 24,141
Passaic 27,777
Paterson ...105,171
Penngrove ...1,826
Perth Amboy 17,699
Phillipsburg 10,052
Plainfield 15,369
Pleasantville. 2,182
Port Oram.....2,069
Princeton 3,899
Rahway 7,935
Raritan 3,244
Red Bank.....5,428
Ridgewood ...2,685
Riverton 1,332
Rockaway 1,483
Roselle 1,652
Rutherford ...4,411
Salem 5,811
Seabright 1,198
Secaucus 1,626
Somerville ...4,843
South Amboy.6,349
South Orange.4,608
South River...2,792
Summit 5,302
Tenafly 1,746
Trenton 73,307
Undercliff 1,006
Union 15,187
Vailsburg 2,779
Vineland 4,370
Wellington 1,812
Washington ..3,580
W. Hoboken.23,094
W. New York.5,267
West Orange.6,889
Woodbury 4,087
Woodstown ...1,371

New Mexico, ter. S. W. part U S., □ 122,580, p. 195,310, * Santa Fe.
Incorporated cities and towns of 1,000 pop. or more in 1900:

Alamogordo ..1,050
Albuquerque. 6,238
Carlsbad 1,063
Deming 1,136
Gallup 2,946
Gardiner 1,120
Las Cruces...1,200
Las Vegas.....3,552
Lincoln 1,000
Mora 1,250
Raton 3,540
Roswell 2,049
Santa Fe......5,603
Silver City....2,735
Socorro 1,512
Taos 1,225

New Orleans, La., p. 287,104.

Newport, Ky., p. 28,301. — (Monmouth), town, Eng., p. 67,290.

New South Wales, state, Australia, □ 310,-367, p. 1,362,232, * Sydney.

Newton, Mass., p. 33,587.

New York, No. Atlantic state, □ 49,170, p. 7,268,894, * Albany.
Incorporated cities and towns of 1,000 pop. or more in 1900:

Adams 1,292
Addison 2,080
Akron 1,585
Albany 94,151
Albion 4,477
Alexandria Bay 1,511
Amityville ...2,038
Amsterdam. 20,929
Athens 2,171
Attica 1,785
Auburn 30,345
Avoca 1,006
Avon 1,601
Babylon 2,157
Bainbridge .. 1,092
Baldwinsv'le 2,992
Ballston Spa..3,923
Batavia 9,180
Bath 4,994
Bath-on-Hudson 2,504
Belmont 1,190
Binghamton 39,647
Bolivar 1,208
Bonnville 1,745
Brewster 1,192
Brockport ...3,398
Buffalo 352,387
Caledonia 1,073
Cambridge ...1,578
Camden 2,370
Canajoharie ..2,101
Canandaigua 6,151
Canastota 3,030
Canisteo 2,077
Canton 2,757
Cape Vincent.1,310
Carthage 2,895
Castile 1,088
Castleton 1,214
Catskill 5,484
Cattaraugus. 1,382
Cazenovia 1,819
Champlain ...1,311
Charlotte 1,400
Chatham 2,018
Chester 1,250
Clayton 1,913
Clifton Spgs..1,617
Clinton 1,340
Clyde 2,507
Cobleskill 2,327
Cohoes 23,910
Cold Spring...2,067
Cooperstown. 2,368
Corinth 2,039
Corning 11,061
Cornwall 1,966
Cortland 9,014
Coxsackie 2,735
Croton-on-Hudson 1,533
Cuba 1,502
Dansville 3,633
Delhi 2,078
Depew 3,379
Deposit 2,051
Dobbs Ferry..2,888
Dolgeville 1,915
Dundee 1,291
Dunkirk 11,616
East Aurora..2,366
East Syracuse.2,509
Ellenville 2,879
Elmira 35,672
Elmira Heights 1,763
Fairport 2,489
Falconer 1,136
Fayetteville ..1,304
Fishkill Landing 3,673
Fonda 1,145
Fort Edward.3,521
Fort Plain....2,444
Frankfort 2,664
Franklinville 1,360
Fredonia 4,127
Freeport 2,612
Friendship ...1,214
Fulton 5,281
Geneseo 2,400
Geneva 10,433
Glens Falls..12,613
Gloversville .18,349
Goshen 2,826
Gouverneur ..3,689
Gowanda 2,143
Granville 2,700
Greene 1,236
Green Island..4,770
Greenport 2,366
Greenwich ...1,869
Groton 1,344
Hamburg 1,683
Hamilton 1,627
Hammondsport 1,169
Hancock 1,283
Hastings-upon-Hudson 2,002
Haverstraw ..5,935
Hempstead ..3,582
Herkimer 5,555
Holley 1,380
Homer 2,381
HoneoyeFalls 1,175
Hoosick Falls.5,671
Hornellsville 11,918
Horseheads ..1,901
Hudson 9,528
Ilion 5,138
Irvington 2,231
Ithaca 13,136
Jamestown ..22,892
Johnstown ..10,130
Jordan 1,118
Keeseville 2,110
Kingston 24,535
Lancaster 3,750
Lansingburg 12,595
Leroy 3,144
Lestershire ..3,111
Liberty 1,760
Little Falls..10,381
Little Valley..1,085
Liverpool 1,133
Lockport 16,581
Lowville 2,352
Lyons 4,300
Malone 5,935
Manlius 1,219
Marathon 1,092
Massena 2,032
Matteawan ...5,807
Mechanicsv'le 4,695
Medina 4,716
Mexico 1,249
Middleburg ..1,135
Middleport ...1,431
Middletown. 14,522
Millbrook 1,027
Mohawk 2,028
Monticello ...1,160
MontourFalls 1,193

New York—Continued.

- **Moravia** 1,442
- **Mt. Kisco**.....1,246
- **Mt. Morris**....2,410
- **Mt. Vernon**..21,228
- **Naples** 1,048
- **Newark** 4,578
- **New Berlin**...1,156
- **Newburg** 24,943
- **NewHartford** 1,007
- **Newpaltz** 1,022
- **New Rochelle** ..14,720
- **New York City** 3,437,202
  - **Manhattan borough** ..1,850,093
  - **Bronx borough** 200,507
  - **Brooklyn borough** ..1,166,582
  - **Richmond borough** 67,021
  - **Queens borough** 152,999
- **Niagara Falls** 19,457
- **North Olean**..1,549
- **Northport** 1,794
- **North Tarrytown** 4,241
- **North Tonawanda** 9,069
- **Northville** 1,046
- **Norwich** 5,766
- **Norwood** 1,714
- **Nunda** 1,018
- **Nyack** 4,275
- **Ogdensburg**. 12,633
- **Olean** 9,462
- **Oneida** 6,364
- **Oneonta** 7,147
- **Ossining** 7,939
- **Oswego** 22,199
- **Oswego Falls**.2,925
- **Owego** 5,039
- **Oxford** 1,931
- **Palmyra** 1,937
- **Patchogue** 2,926
- **Peekskill** 10,358
- **Penn Yan**.....4,650
- **Perry** 2,763
- **Phelps** 1,306
- **Philmont** 1,964
- **Phoenix** 1,532
- **Piermont** 1,153
- **Pittsford** 1,000
- **Plattsburg** ...8,434
- **Pleasantv'le**. 1,204
- **Port Byron**...1,013
- **Port Chester**..7,440
- **Port Henry**...1,751
- **Port Jervis**...9,385
- **Potsdam** 3,843
- **Poughkeepsie** 24,029
- **Pulaski** 1,493
- **Randolph** 1,209
- **Rensselaer** ...7,466
- **Rhinebeck** ...1,494
- **Richfield Springs** 1,537
- **Rochester** ..162,608
- **Rockton** 1,052
- **Rockville Centre** 1,884
- **Rome** 15,343
- **Rosendale** 1,840
- **Rouse Point**..1,675
- **Sacketts Harbor** 1,266
- **Sag Harbor**...1,969
- **St. Johnsville** 1,873
- **Salamanca** ...4,251
- **Salem** 1,391
- **Sandy Hill**....4,473
- **Saranac Lake** 2,594
- **Saratoga Springs** ...12,409
- **Saugerties** ...3,697
- **Schaghticoke** 1,061
- **Schenectady** 31,682
- **Schoharie** 1,006
- **Schuylerville** 1,601
- **Sea Cliff**......1,558
- **Seneca Falls**..6,519
- **Sidney** 2,331
- **Silver Creek**..1,944
- **Skaneateles** ..1,495
- **Solvay** 3,493
- **Southampton** 2,289
- **South Glens Falls** 2,025
- **South Nyack**..1,601
- **Springville** ...1,992
- **Stillwater** 1,007
- **Suffern** 1,619
- **Syracuse** ...108,374
- **Tarrytown** ...4,770
- **Ticonderoga** . 1,911
- **Tivoli** 1,153
- **Tonawanda** ..7,421
- **Troy** 60,651
- **Trumansburg** 1,225
- **Unadilla** 1,172
- **Utica** 56,383
- **Valatie** 1,300
- **Walden** 3,147
- **Walton** 2,811
- **Wappingers Falls** 3,504
- **Warsaw** 3,048
- **Warwick** 1,735
- **Waterford** 3,146
- **Waterloo** 4,256
- **Watertown** . 21,696
- **Waterville** ...1,571
- **Watervliet** . 14,321
- **Watkins** 2,943
- **Waverly** 4,465
- **Wayland** 1,307
- **Weedsport** ...1,525
- **Wellsville** ...3,556
- **W. Carthage**..1,135
- **Westfield** 2,430
- **West Haverstraw** 2,079
- **Whitehall** 4,377
- **White Plains**.7,899
- **Whiteboro** ...1,958
- **Wolcott** 1,279
- **Yonkers** 47,931

New Zealand, group of isls., S. E. of Australia, British, □ 104,471, p. 796,359, * Wellington, p. 37,441.

Nganhwei, prov. China, □ 53,000, p. 20,596,000.

Nicaragua, republic of Cen. Am., □ 49,200, p. 380,000, * Managua, p. 25,000.

Nice, city, France, p. 125,100.

Nigeria, region on Gulf of Guinea, W. Africa, British. Est. area, □ 500,000, p. est. 25 to 40 millions. Divided into Northern and Southern Nigeria.

Niigata, city, Japan, p. 53,366.

Nikolaiev, city, Russia, p. 92,060.

Nimes, city, France, p. 74,601.

Niuchwang, city, Manchuria, p. 60,000.

Nishni-Novgorod, city, Russia, p. 95,124

Norfolk, Va., p. 46,624. — Co. Eng., □ 2,037, p. 313,438.

Norrkoping, city, Sweden, p. 40,472.

North America, see **America**.

Northampton, co. Eng., □ 914, p. 207,467. — Its * p. 87,021.

North Carolina, So. Atlantic state, □ 52,250, p. 1,893,810, * Raleigh.

Incorporated cities and towns of 1,000 pop. or more in 1900:

- **Albemarle** 1,382
- **Asheville** 14,694
- **Beaufort** 2,195
- **Bessemer City** 1,100
- **Burlington** ...3,692
- **Caroleen** 1,706
- **Chapel Hill**...1,099
- **Charlotte** 18,091
- **Cherryville** ...1,008
- **Concord** 7,910
- **Dunn** 1,072
- **Durham** 6,679
- **Edenton** 3,046
- **Elizabeth City**.6,348
- **Fayetteville** ..4,670
- **Forest City**...1,090
- **Gastonia** 4,610
- **Goldsboro** 5,877
- **Graham** 2,052
- **Greensboro** .10,035
- **Greenville** 2,565
- **Henderson** ...3,746
- **Hendersonville** 1,917
- **Henrietta** 1,250
- **Hertford** 1,382
- **Hickory** 2,535
- **High Point**....4,163
- **Kings Mountain** 2,062
- **Kinston** 4,106
- **Laurinburg** ..1,334
- **Lenoir** 1,296
- **Lexington** 1,234
- **Louisburg** 1,178
- **McAdenville** .1,144
- **Marion** 1,116
- **Monroe** 2,427
- **Mooresville** ..1,533
- **Morehead City** 1,379
- **Morganton** ...1,938
- **Mt. Airy**......2,680
- **Newbern** 9,090
- **Newton** 1,583
- **Oxford** 2,059
- **Plymouth** 1,011
- **Raleigh** 13,643
- **Randleman** ..2,190
- **Reidsville** 3,262
- **Roanoke Rapids** 1,009
- **Rockingham** .1,507
- **Rocky Mount**.2,937
- **Roxboro** 1,021
- **Salem** 3,642
- **Salisbury** 6,277
- **Sanford** 1,044
- **Scotland Neck** 1,348
- **Shelby** 1,874
- **Southport** 1,336
- **Statesville** ...3,141
- **Tarboro** 2,499
- **Wadesboro** ...1,546
- **Washington** ..4,842
- **Waynesville** .1,307
- **Weldon** 1,433
- **Wilmington** .20,976
- **Wilson** 3,525
- **Winston** 10,008

North Dakota, No. Central state, □ 70,795, p. 319,146, * Bismarck.

Incorporated cities and towns of 1,000 pop. or more in 1900:

- **Bismarck** 3,319
- **Cando** 1,061
- **Casselton** 1,207
- **Devils Lake**...1,729
- **Dickinson** 2,076
- **Fargo** 9,589
- **Grafton** 2,378
- **Grand Forks**..7,652
- **Hillsboro** 1,172
- **Jamestown** ...2,853
- **Langdon** 1,188
- **Larimore** 1,235
- **Lisbon** 1,046
- **Mandan** 1,658
- **Mayville** 1,106
- **Minot** 1,277
- **Park River**...1,0S8
- **Valley City**...?,446
- **Wahpeton** 2,228

Northumberland, co. Eng., □ 2,007, p. 388,059.

North-West Provinces, states, Brit. India, □ 5,109, p. 799,675.

Norway, kingdom, N. Europe, □ 124,445, p. 2,231,395, * Christiania.

Norwich, city, Eng., p. 11,728.

Nossi-Be Island, w. coast of Madagascar, of which it is a dependency, □ 130, p. 9,500.

Nottingham, co. Eng., □ 826, p. 274,684. — Its * p. 239,753.

Novara, city, Italy, p. 47,300.

Nova Scotia, prov. Canada, □ 20,600, p. 459,116, * Halifax.

Novotcherkask, city, Russia, p. 52,005.

Nuevo Leon, state, Mex., □ 23,592, p. 307,856.

Nuremberg, city, Bavaria, Germany, p. 261,022.

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Oakland, Cal., p. 66,960.

Oaxaca, state, Mex., □ 35,382, p. 872,902. — Its * p. 32,437.

Odense, city, Denmark, p. 30,277.

Odessa, city, Russia, p. 405,041.

Offenbach, city, Hesse, Germany, p. 39,406.

Ohio, No. Central state, □ 41,060, p. 4,157,-545, * Columbus.
Incorporated cities and towns of 1,000 pop. or more in 1900:

Ada 2,576
Addyston 1,513
Akron 42,728
Alliance 8,974
Antwerp 1,206
Arcanum 1,225
Ashland 4,087
Ashtabula ...12,949
Athens 3,066
Barberton 4,354
Barnesville ..3,721
Batavia 1,029
Bedford 1,486
Bellaire 9,912
Bellefontaine 6,649
Bellevue 4,101
Bellville 1,039
Berea 2,510
Blanchester ..1,788
Bluffton 1,783
Bond Hill.....1,081
Bowling Green 5,067
Bradford 1,254
Bradner 1,148
Bridgeport ...3,963
Bryan 3,131
Bucyrus 6,560
Byesville 1,267
Cadiz 1,755
Cambridge ...8,241
Canal Dover..5,422
Canal Fulton..1,172
Canton 30,667
Cardington ..1,354
Carey 1,816
Carrollton 1,271
Carthage 2,559
Cedarville 1,189
Celina 2,815
Chagrin Falls.1,586
Chardon 1,360
Chicago Jct...2,348
Chillicothe ..12,976
Cincinnati ..325,902
Circleville 6,991
Cleveland ..381,768
Cleves 1,328
Clyde 2,515
Coalgrove 1,191
Coalton 1,625
College Hill..1,104
Collinwood ...3,639
Columbiana ..1,339
Columbus ..125,560
Columbus Grove 1,935
Conneaut 7,133
Continental ..1,104
Corning 1,401
Coshocton 6,473
Covington 1,791
Crestline 3,282
Cuyahoga Falls 3,186
Dayton 85,333
Defiance 7,579
DeGraff 1,150
Delaware 7,940
Delphos 4,517
Delta 1,230
Dennison 3,763
Deshler 1,628
Doylestown ..1,057
Dresden 1,600
Dunkirk 1,222
E. Cleveland..2,757
E. Liverpool.16,485
E. Palestine...2,493
Eaton 3,155
Edgerton 1,043
Elmore 1,025
Elmwood Place 2,532
Elyria 8,791
Evanston 1,716
Fairport 2,078
Findlay 17,613
Forest 1,155
Ft. Recovery..1,097
Fostoria 7,730
Franklin 2,724
Fremont 8,439
Galion 7,282
Gallipolis 5,432
Garettsville ..1,145
Geneva 2,342
Georgetown ..1,529
Germantown .1,702
Gibsonburg ..1,791
Girard 2,630
Glendale 1,545
Glenville 5,588
Glouster 2,155
Grafton 1,098
Granville 1,425
Greenfield 3,979
Greenville 5,501
Hamilton 23,914
Harrison 1,456
Hartwell 1,833
Hicksville 2,520
Hillsboro 4,535
Holgate 1,237
Hubbard 1,230
Huron 1,708
Hyde Park....1,691
Irondale 1,136
Ironton 11,868
Jackson 4,672
Jacksonville .1,047
Jamestown ...1,205
Jefferson 1,319
Kelleys Island 1,174
Kent 4,541
Kenton 6,852
Lakewood 3,355
Lancaster 8,991
Lebanon 2,867
Leetonia 2,744
Leipsic 1,726
Lima 21,723
Lisbon 3,330
Lockland 2,695
Logan 3,480
London 3,511
Lorain 16,028
Loudonville ..1,581
Louisville 1,374
Loveland 1,260
Lowellville ...1,137
McComb 1,195
McConnelsville 1,825
Madisonville .3,140
Manchester ...2,003
Mansfield 17,640
Marietta 13,348
Marion 11,862
Martins Ferry 7,760
Marysville 3,048
Massillon 11,944
Maumee 1,856
Mechanicsv'le 1,617
Medina 2,232
Miamisburg ..3,941
Middleport ...2,799
Middletown ..9,215
Milford 1,149
Millersburg ..1,998
Mineral City..1,220
Minerva 1,200
Mingo Jct.....2,954
Minster 1,465
Monroeville ..1,211
Montpelier ...1,869
Mt. Gilead....1,528
Mt. Healthy..1,354

Ohio.—Continued.

Mt. Vernon...6,633
Murray City..1,118
Napoleon 3,639
Nelsonville ...5,421
Newark 18,157
New Bremen..1,318
Newburg 5,909
New Comerstown 2,659
New Lexington (Perry Co.).1,701
New London..1,180
New Philadelphia 6,213
N. Richmond.1,916
N. Straitsv'le 2,302
Niles 7,468
North Amherst 1,758
North Baltimore 3,561
Norwalk 7,074
Norwood 6,480
Oak Harbor...1,631
Oberlin 4,082
Orrville 1,901
Ottawa 2,322
Oxford 2,009
Painesville ...5,024
Paulding 2,080
Payne 1,336
Pemberville ..1,081
Perrysburg ...1,766
Piqua 12,172
Plain City.....1,432
Pleasant City.1,006
Plymouth 1,154
Pomeroy 4,639
Port Clinton..2,450
Portsmouth .17,870
Ravenna 4,003
Reading 3,076
Richwood 1,640
Ripley 2,248
Rockford 1,207
Rockport 2,038
Rocky River..1,319
Roseville 1,207
Sabina 1,481
St. Bernard...3,384
St. Clairsv'le.1,210
St. Marys.....5,359
St. Paris......1,222
Salem 7,582
Salineville ...2,353
Sandusky 19,664
Scio 1,214
Shawnee 2,966
Shelby 4,685
Shreve 1,043
Sidney 5,688
Somerset 1,124
S. Brooklyn...2,343
S. Charleston.1,096
Spencerville ..1,874
Springfield ..38,253
Steubenville .14,349
Stryker 1,206
Tiffin 10,989
Tippecanoe ...1,703
Toledo 131,822
Toronto 3,526
Troy 5,881
Uhrichsville .4,582
Union City....1,282
Upper Sandusky 3,355
Urbana 6,808
Van Wert.....6,422
Vermilion 1,184
Versailles 1,478
Wadsworth ...1,764
Wapakoneta .3,915
Warren 8,529
Washington Court House 5,751
Washingtonville 1,092
Wauseon 2,148
Waverly 1,854
Wellington ...2,094
Wellston 8,045
Wellsville 6,146
Westerville ..1,462
West Liberty.1,236
West Union...1,033
Williamsburg 1,002
Willoughby ..1,753
Wilmington ..3,613
Winton Place.1,219
Woodsfield ...1,801
Wooster 6,063
Wyoming 1,450
Xenia 8,696
Yellow Spgs...1,371
Youngstown .44,885
Zanesville ...23,538

Okayama, city, Japan, p. 58,025.

Oklahoma, ter. So. Central pt. U. S., □ 39,030, p. 398,331, * Guthrie.
Incorporated cities and towns of 1,000 pop. or more in 1900:

Alva 1,499
Blackwell 2,283
Chandler 1,430
Elreno 3,383
Enid 3,444
Guthrie 10,006
Hennessey ...1,367
Kingfisher ...2,301
Newkirk 1,754
Norman 2,225
Oklahoma City 10,037
Pawnee 1,464
Perry 3,351
Ponca 2,528
Shawnee 3,462
Stillwater 2,431
Tecumseh 1,193
Weatherford .1,017

Oldenburg, Ger. grand-duchy, □ 2,479, p. 398,499, * Oldenburg, p. 25,472.
Oldham, city, Eng., p. 137,238.
Old Marghelan, city, Rus. Turkestan, p. 36,592.
Omaha, Neb., p. 102,555.
Oman, ind. state, S. E. Arabia, □ 82,000, p. 1,500,000, * Muscat.
Omsk, city, Siberia, p. 37,470.
Ontario, prov., Canada, □ 232,000, p. 2,167,-978, * Toronto.
Oporto, city, Portugal, p. 138,860.
Oran, city, Algeria, p. 85,081.
Orange Free State, see Orange River Colony.
Orange River Colony, British, So. Africa, □ 48,326, p. 207,503, * Bloemfontein.

Oregon, Western state, □ 96,030, p. 413,536, * Salem.
Incorporated cities and towns of 1,000 pop. or more in 1900:

Albany 3,149
Ashland 2,634
Astoria 8,381
Baker City....6,663
Corvallis 1,819
Dallas 1,271
Eugene 3,236
Forest Grove.1,096
Grants Pass...2,290
Heppner 1,146
LaGrande 3,991
McMinnv'le ..1,420
Marshfield ...1,391
Medford 1,791
Oregcn City..3,494
Pendleton 4,406
Portland 90,426
Roseburg 1,690
Salem 4,258
The Dalles....3,542

Orel, city, Russia, p. 69,858.
Orenburg, city, Russia, p. 72,740.
Orizaba, city, Mexico, p. 31,512.
Orleans, city, France, p. 66,619.
Osaka, city, Japan, p. 821,235.
Osh, city, Rus. Turkestan, p. 36,474.
Oshkosh, Wis., p. 28,284.
Ostend, city, Belgium, p. 38,481.
Otaru, city, Japan, p. 56,961.
Ottawa, * Canada, p. 59,902.
Ottoman Empire, see **Turkey**.
Oudh, prov., Brit. India, □ 24,217, p. 12,884,150.
Ouro Preto, city, Brazil, p. 59,249.
Oviedo, city, Spain, p. 46,376.
Oxford, co., Eng., □ 750, p. 137,118. — Its * p. 49,413.

P

Pachuca, city, Mexico, p. 37,487.
Padua, city, Italy, p. 83,748.
Paisley, city, Scotland, p. 79,355.
Palermo, city, Italy, p. 292,799.
Palma, city, Balearic Islands, Spain, p. 62,525.
Panama, city, Colombia, p. 30,000.
Panay, isl., Philippines, □ 4,700.
Paraguay, republic, So. Am., □ 98,000, p. 600,000, * Asuncion.
Paramar'ibo, * Dutch Guiana, p. 31,200.
Paris, * France, on Seine R., p. 2,685,438.
Parma, city, Italy, p. 55,205.
Partick, city, Scotland, p. 54,274.
Passaic, N. J., p. 27,777.
Paterson, N. J., p. 105,171.
Patna, city, India, p. 135,172.
Patras, city, Greece, p. 37,958.
Pau, city, France, p. 33,012.
Pavia, city, Italy, p. 38,722.
Pawtucket, R. I., p. 39,231.
Peking, * Chinese Empire, p. (est.) 1,300.000.
Pelew (Palao) **Islands**, group in N. Pacific, belong to Germany.
Pelotas, city, Brazil, p. 41,591.
Pembroke, co., Wales, □ 614, p. 87,910. — City, Ireland, p. 25,524.
Pennsylvania, No. Atlantic state, □ 45,215, p. 6,302,115, * Harrisburg.
Incorporated cities and towns of 1,000 pop. or more in 1900:

Allegheny ..129,896
Allentown ...35,416
Altoona 38,973
Ambler 1,884
Apollo 2,924
Archbald 5,396
Arnold 1,426
Ashland 6,438
Ashley 4,046
Aspinwall 1,231
Athens 3,749
Austin 2,300
Avalon 2,130
Avoca 3,487
Bangor 4,106
Barnesboro ...1,482
Beaver 2,348
Beaver Falls.10,054
B'ver M'dows.1,378
Bedford 2,167
Bellefonte 4,216
Bellevernon ..1,901
Bellevue 3,416
Bellwood 1,545
Berlin 1,030
Berwick (ColumbiaCo.).3,916
Bethlehem ...7,293
Birdsboro 2,264
Blairsville 3,386
Blakely 3,915
Bloomsburg ..6,170
Blossburg 2,423
Boyertown.. ..1,709
Braddock. ...15,654
Bradford......15,029
Bridgeport (Fayette Co.)....1,805
Bridgeport (Montgomery Co.)..3,097
Bridgewater ..1,347
Bristol.........7,104
Brockwayville 1,777
Brookville.....2,472
Brownsville. ..1,552
Butler.... 10,853
California.... ..2,008
Cambridge Sp's1,495

Pennsylvania.—Continued.

Canonsburg 2,714
Canton 1,525
Carbondale 13,536
Carlisle 9,626
Carnegie 7,330
Catasauqua 3,963
Catawissa 2,023
Centralia 2,048
Chambersburg ..8,864
Charleroi 5,930
Chester 33,988
Clarendon 1,092
Clarion 2,004
Clayville (Jefferson Co.).......2,371
Clearfield 5,081
Clifton Heights.2,330
Coatesville 5,721
Columbia .... .12,316
Colwyn 1,226
Connellsville ..7,160
Conshohocken ..5,762
Coplay 1,581
Corapolis 2,555
Corry 5,369
Coudersport 3,217
Crafton 1,927
Cressona 1,738
Curwensville ...1,937
Dale 1,503
Dallastown 1,181
Danville 8,042
Darby 3,429
Derry 2,347
Dickson 4,948
Dorrance 2,211
Downingtown ..2,133
Doylestown 3,034
Dubar 1,662
Dubois 9,375
Duncannon 1,661
Duncansville ...1,512
Dunmore 12,583
Duquesne 9,036
East Brady......1,233
E. Conemaugh..2,175
E. Greensburg..1,050
East Mauch Chunk 3,458
Easton 25,238
East Pittsburg ..2,883
E. Stroudsburg .2,648
E. Washington..1,051
Ebensburg 1,574
Edgewood 1,139
Edwardsville ...5,165
Elizabeth 1,866
Elizabethtown .1.473
Elkland 1,109
Elliott 3,345
Ellwood City....2,243
Emaus 1,468
Emlenton 1.190
Emporium 2,463
Ephrata 2,451
Erie 52,733
Esplen 2,364
Etna 5,384
Evans City......1,203
Everett 1.864
Exeter 1,948
Fairchance 1,219
Fayette City....1,595
Ford City.......2,870
Forest City......4,279
Forty Fort......1,557
Fountain Hill...1,214
Frackville 2,594
Franklin (Venango Co.)....7,317
Freedom 1,783
Freeland 5,254
Freeport 1,754
Galeton 2,415
Gallitzin 2,759
Gettysburg 3,495
Gilberton 4,373
Girardville 3,666
Glen Campbell..1,628
Glen Rock.......1,117
Gordon 1,165
Greencastle 1,463
Greensburg 6,508
Greenville 4,814
Grove City......1,599
Hallstead 1,404
Hamburg 2,315
Hanover 5,302
Harrisburg 50,167
Hastings 1,621
Hawley 1,925
Hazelton 14,230
Hollidaysburg ..2,998
Homestead 12,554
Honesdale 2,864
Houtzdale 1,482
Hughestown 1,548
Hughesville 1,528
Hummelstown ..1,729
Huntingdon 6,053
Hyndman 1,242
Indiana 4,142
Irwin 2,452
Jeannette 5,865
Jeddo 1,632
Jenkintown 2,091
Jermyn 2,567
Jersey Shore....3,070
Johnsonburg ...3,894
Johnstown 35,936
Juniata 1,709
Kane 5,296
Kennett Square.1,516
Kingston 3,846
Kittanning 3,902
Knoxville (Allegheny Co.)....3,511
Kutztown 1,328
Lancaster 41,459
Lansdale 2,754
Lansdowne 2,630
Lansford 4,888
Latrobe 4,614
Lebanon 17,628
Leechburg 2,459
Lehighton 4,629
Lewisburg 3,457
Lewistown 4,451
Ligonier 1,259
Lilly 1,276
Lititz 1,637
Littlestown 1,118
Lock Haven......7,210
Luzerne 3,817
Lykens 2,762
McAdoo 2,122
McDonald 2,475
McKeesport ...34,227
McKees Rock...6,352
McSherrystown 1,490
Mahanoy City..13,504
Manheim 2,019
Mansfield 1,847
Marcus Hook...1,209
Marietta 2,469
Marysville 1,463
Mauch Chunk...4,029
Mayfield 2.300
Meadville 10,291
Mechanicsburg (Cumbr'd Co.).3.841
Media 3,075
Mercer 1,804
Meyersdale 3,024
Middletown 5,608
Miffinburg 1,436
Millersburg 1,675
Mill Hall........1.010
Millvale 6.736
Milton 6,175
Miners Mills....2,224
Minersville 4,815
Monaca 2,008
Monessen 2,197
Monongahela ...5,173
Montgomery 1,063

Pennsylvania.—Continued.

Montoursville ..1,665
Montrose 1,827
Moosic 1,227
Morrisville 1,371
Mt. Carmel.....13,179
Mt. Holly Sp's..1,328
Mt. Jewett......1,553
Mt. Joy..........2,018
Mt. Oliver.......2,295
Mt. Pleasant....4,745
Mt. Union.......1,085
Muncy 1,934
Nanticoke 12,116
Nazareth 2,304
Nescopeck 1,100
New Bethlehem.1,269
New Brighton..6,820
Newcastle 28,339
New Cumberland 1,035
New Haven......1,532
New Hope.......1,218
New Kensington 4,665
New Philadelphia 1,326
Newport 1,734
Newtown 1,463
Newville 1,655
Norristown 22,265
North Braddock.6,535
Northeast 2,068
Northumberland 2,748
North Wales....1,287
North Washington.............1,473
North York.....1,185
Norwood 1,286
Oakdale 1,147
Oakland 1,003
Oakmont 2,323
Oil City........13,264
Old Forge......5,630
Olyphant 6,180
Orwigsburg 1,518
Osceola (Clearfield Co.)......2,030
Oxford 2,032
Palo Alto........1,707
Parker's Landing 1,070
Parkersburg 1,788
Parnassus 1,791
Parsons 2,529
Patton 2,651
Pen Argyl.......2,784
Pennsburg 1,032
Perkasie 1,803
Philadelphia 1,293,697
Philipsburg 3,266
Phoenixville 9,196
Pinegrove 1,084
Pitcairn 2,601
Pittsburg 321,616
Pittston 12,556
Plymouth 13,649
Polk 1,037
Port Allegany...1,853
Port Carbon....2,168
Port Vue........1,803
Pottstown 13,696
Pottsville 15,710
Prospect Park..1,050
Punxsutawney. 4,375
Quakertown 3,014
Rankin 3,775
Reading 78,961
Red Lion........1,337
Renovo 4,082
Reynoldsville ..3,435
Ridgway 3,515
Ridley Park.....1,234
Roaring Spring.1,344
Rochester 4,688
Roscoe 1,354
Royalton 1,106
Royersford 2,607
St. Clair.........4,638
St. Marys.......4,295
Sayre...........5,243
Schuylkill Haven 3,654
Scottdale.........4,261
Scranton.........102,026
Selinsgrove.. ...1,326
Sellersville......1,247
Sewickley 3,568
Shamokin 18,202
Sharon 8,916
Sharon Hill.....1,058
Sharpsburg 6,842
Sharpsville 2,970
Shenandoah ...20,321
Sheraden 2,948
Shickshinny 1,456
Shippensburg .. 3,228
Slatington 3,773
Smethport 1,704
Somerset 1,834
Souderton 1,077
South Bethlehem (Northampton Co.). 13,241
South Fork......2,635
South Washington 1,230
South Waverly 1,215
South Williamsport 3,328
Spangler 1,616
Spring City.....2,566
Spring Garden . 1,015
Steelton 12,086
Spring Grove....1,005
Stoneboro 1,061
Stroudsburg ...3,450
Sugar Notch....1,887
Summit Hill....2,986
Sunbury 9,810
Susquehanna ..3,813
Swissvale 1,716
Swoyersville 2,264
Tamaqua 7,267
Tarentum 5,472
Taylor 4,215
Throop 2,204
Tidioute 1,237
Titusville 8,244
Towanda 4,663
Tower City......2,167
Tremont.........1,947
Troy.............1,450
Tunkhannock ..1,305
Turtle Creek....3,262
Tyrone...........5.847
Union City......3,104
Uniontown (Fayette Co.) 7,344
Upland...........2,131
Vandergrift. 2,076
Vandergrift Heights........1,910
Verona.. 1,904
Warren..........8,043
Washington (Washington Co.)....7,670
Watsontown 1,898
Waynesboro 5,396
Waynesburg 2,544
Weatherly 2,471
Wellsboro 2,954
West Bethlehem 3,465
West Chester...9,524
West Conshohocken 1,958
West Easton....1,000
Westfield 1,180
West Hazelton..2,516
West Liberty....1,281
West Newton....2,467
West Pittston...5,846
West Washington 2,693
West Wyoming 1,344

Pennsylvania.—Continued.

White Haven....1,517
Wilkesbarre ...51,721
Wilkinsburg ..11,886
Williamsport ..28,757
Williamstown ..2,934
Wilmerding 4,179
Winton 3,425
Womelsdorf 1,136
Wrightsville 2,266
Wyoming 1,909
York 33,708
Yorkville 1,125

Penza, city, Russia, p. 61,851.
Peoria, Ills., p. 56,100.
Perpignan, city, France, p. 35,088.
Perigueux, city, France, p. 31,313.
Perim, isl. str. of Bab-el-Mandeb (British), □ 5.
Pernambuco, city, Brazil, p. 111,556.
Persia, kingdom, S. W. Asia, □ 628,000, p. 7,653,600, * Teheran.
Perth, town, Scotland, p. 32,872. — * Western Australia, p. 34,610.
Peru, republic, So. Am., □ 695,733, p. 4,610,-000, * Lima.
Perugia, city, Italy, p. 61,292.
Pesaro, city, Italy, p. 27,206.
Peterborough, soke of, Northampton Co., Eng., □ 84, p. 41,119.
Pforzheim, city, Baden, Germany, p. 33,345.
Philadelphia, Pa., p. 1,293,697.
Philippine Islands, group of about 2,000 isls., S. E. of China, total area est. at □ 115,-500, p. est. 8,000,000, * Manila.

Area of the largest islands:

	Sq. Mi.		
Luzon	44,000	Leyte	3,800
Mindanao	37,500	Negros	3,300
Samar	4,800	Cebu	2,400
Panay	4,700	Nasbate	1,400
Mindoro	4,000	Bohol	1,300

Principal cities:

	Pop.		
Manila	350,000	Argao	34,050
Lipa	40,000	Albay	34,000
Banang	39,500	Taal	33,380
Batangas	39,300	Carcar	30,300
Laoang	37,000	Calbayog	30,250
Cebu	35,240		

Philippopolis, * E. Rumelia, p. 41,068.
Piacenza, city, Italy, p. 35,319.
Pilsen, city, Austria, p. 68,292.
Piraeus, city, Greece, p. 42,169.
Pirmasens, city, Bavaria, Germany, p. 24,-548.
Pisa, city, Italy, p. 66,567.
Pittsburg, Pa., p. 321,616.
Plauen, city, Saxony, p. 55,191.
Plymouth, city, Eng., p. 107,509.
Poitiers (or Poictiers), city, France, p. 38,-518.
Pola, city, Austria, p. 39,273.
Poland, prov. Russia, □ 49,159, p. 9,455,943.
Poltava, city, Russia, p. 53,060.
Ponce, city, Porto Rico, p. 27,952.
Poona, city, India, p. 111,385.
Port-au-Prince, * Haiti, p. 50,000.
Portland, Me., p. 50,145. — Ore., p. 90,426.
Porto Alegre, city, Brazil, 52,421.
Porto Rico, isl. West Indies, E. of Haiti, ter. of U. S., area (including islets of Vieques, Culebra, Mona and Muertos) □ 3,606, p. 953,243, * San Juan.

Cities of more than 5,000 pop., in 1899:

Aguadilla	6,425	Mayaguez	15,187
Arecibo	8,008	Ponce	27,952
Caguas	5,450	San Juan	32,048
Guayama	5,334	Yauco	6,108

Port Said, city, Egypt, p. 42,095.
Portsmouth, city, Eng., p. 189,160.
Portugal, kingdom, S. W. Europe, □ 34,528, p. 4,660,095, * Lisbon.
Portuguese East Africa, E. of Transvaal, □ 301,000, p. 3,120,000, * Lorenzo Marques, p. 6,630.
Portuguese Guinea, W. Africa, □ 4,440, p. 820,000.
Portuguese West Africa, see **Angola**.
Posen, city, Prussia, p. 117,014.
Potsdam, city, Prussia, p. 58,455.
Possong, city, Hungary, p. 61,861.

Prague, city, Austria, p. 204,478.
Preston, city, Eng., p. 112,982.
Pretoria, * Transvaal, p. (whites) 10,000.
Prince Edward Island, G. of St. Lawrence, prov. of Canada, □ 2,000, p. 103,258, * Charlottetown.
Providence, * R. I., p. 175,597.
Prussia, Ger. kingdom, □ 134,603, p. 34,463,-377, * Berlin.
Przemysl, city, Austria, p. 35,619.
Puebla, state, Mex., □ 12,204, p. 973,876. — Its * p. 93,521.
Pueblo, Colo., p. 28,157.
Puerto Principe, city, Cuba, p. 25,102.
Punjab, prov. Brit. India, □ 110,667, p. 22,-449,484.
Punjab, states, Brit. India, □ 22,509, p. 4,438,816.

Q

Quebec, prov. Canada, □ 347,350, p. 1,620,974, * Montreal. — city, Canada, p. 68,834.
Queensland, state, Australia, □ 668,497, p. 502,892, * Brisbane.
Queretaro, state, Mex., □ 3,556, p. 224,848. — Its * p. 34,576.
Quetta, city, Baluchistan, India.
Quincy, Ill., p. 36,252.
Quito, * Ecuador, p. 80,000.

R

Racine, Wis., p. 29,102.
Radnor, co., Wales, □ 471, p. 23,263.
Rajputana, state, India, □ 128,022, p. 9,841,-032.
Rampur, city, India, p. 77,862.
Rangoon, city, India, p. 232,326.
Rathmines and Rathgar, city, Ireland, p. 32,472.
Ratisbon, city, Bavaria, Germany, p. 41,471.
Ravenna, city, Italy, p. 68,065.
Reading, Pa., p. 78,961. — town, Eng., p. 72,214.
Reggio di Calabria, city, Italy, p. 46,685.
Reggio nell'Emilia, city, Italy, p. 60,462.
Rennes, city, France, p. 69,937.
Reunion, isl., 420 miles E. of Madagascar, belongs to France, □ 965, p. 173,192. Chief towns, St. Denis, St. Pierre, St. Paul and St. Louis.
Reuss, Aeltere Linie, Ger. principality, □ 122, p. 68,287, * Greiz, p. 22,296.
Reuss, Juengere Linie, Ger. principality, □ 319, p. 138,993, * Gera.
Reval, city, Russia, p. 64,578.
Rheims, city, France, p. 107,800.
Rhode Island, No. Atlantic state, □ 1,250, p. 428,556, * * Providence and Newport.
Incorporated cities and town of 1,000 pop. or more in 1900:

Central Falls..18,167	Providence ..175,597
Newport 22,034	Woonsocket ...28,204
Pawtucket 39,231	

Rhodesia, large tract in So. Central Africa, div. by Zambesi Riv. into Northern and Southern Rhodesia, British, est. area □ 362,000, p. (est.) 800,000. See **Matabeleland** and **Mashonaland**.
Richmond, * Va., p. 85,050.
Riga, city, Russia, p. 256,197.
Rio de Janeiro, * Brazil, p. 780,000.
Rio de Oro and Adrar, Sp. possess. W. Africa, □ 243,000, p. 100,000.
Roanne, city, France, p. 33,912.
Rochdale, town, p. 83,112.
Rochefort, city, France, p. 34,329.
Rochester, N. Y., p. 162,608.
Rockford, Ill., p. 31,051.
Rome, * Italy, p. 512,423.
Rosario, city, Argentine Rep., p. 94,025.
Rostock, city, Mecklenburg-Schwerin, Germany, p. 49,912.
Rostov on Don, city, Russia, p. 119,889.
Rotterdam, city, Holland, p. 319,866.
Roubaix, city, France, p. 124,700.
Rouen, *city*, France, p. 115,900.
Rudolstadt, * Schwarzburg-Rudolstadt, Germany, p. 11,907.
Rumania, kingdom, E. Europe, □ 50,700, p. 5,912,600, * Bucharest.
Russia, empire, □ 8,644,100, p. 129,000,000, * St. Petersburg.
Rustchuk, city, Bulgaria, p. 37,174.
Rutland, co., Eng., □ 152, p. 19,708.

S

Sacramento, * Cal., p. 29,282.
Saginaw, Mich. p. 42,345.
Saharanpur, city, India, p. 63,850.
Sakai, city, Japan, p. 52,203.
Salem, city, India, p. 70,627.
Salerno, city, Italy, p. 39,239.
Salford, city, Eng., p. 220,956.
Salonica, city, Turkey, p. 105,000.
Salop, co., Eng., □ 1,343, p. 239,297.
Saltillo, city, Mexico, p. 26,801.
Salvador, republic, Cen. Am., □ 7,225, p. 803,534, * San Salvador, p. 50,000.
Salzburg, prov. Austria, □ 2,767, p. 193,247.
St. Croix, isl. West Indies, belongs to Denmark, □ 74, p. 18,000.
St. Denis, city, France, p. 54,432.
St. Etienne, city, France, p. 146,700.
St. Helena, isl. So. Atlantic, British, □ 47, p. 5,000.
St. Helens, town, Eng., p. 84,410.
St. John, city, New Brunswick, Canada, p. 40,711. — Isl. West Indies, belongs to Denmark, □ 23, p. 1,000.
St. Joseph, Mo., p. 102,979.
St. Louis, Mo., p. 575,238.
Ste. Marie, No. coast of Madagascar of which it is a dependency, □ 64, p. 9,-500.
St. Nazaire, city, France, p. 30,813.
St. Nicholas, city, Belgium, p. 30,288.
St. Ouen, city, France, p. 30,715.
St. Paul, * Minn., p. 163,065.
St. Paul de Loanda, * Angola, p. 15,000.
St. Petersburg, * Russia, p. 1,267,023.
St. Quintin, city, France, p. 48,868.
St. Thomas, isl. West Indies, belongs to Denmark, □ 23, p 17,000.
Salem, Mass., p. 35,956.
Salt Lake City, * Utah, p. 53,531.
Samar, isl. Philippines, □ 4,800.
Samara, city, Russia, p. 91,672.
Samarcand, city, Rus. Turkestan, p. 54,900.
Samoa (or Navigator Islands), group in So. Pacific, belongs to Germany and U. S., □ 1,076.
Samos, isl. Mediterranean, Turkish principality, □ 180, p. 54,830, * Vathi.
San Antonio, Tex., p. 53,321.
San Francisco, Cal., p. 342,782.
San Jose, * Costa Rica, p. 25,000.
San Juan, * Porto Rico, p. 32,048.
San Luis Potosi, state, Mexico, □ 25,316, p. 562,195. — Its * p. 61,009.
San Marino, republic, Italian pen., □ 23, p. 9,500.
Santa Cruz, city, Canary Isl., p. 33,421.
San Paulo, city, Brazil, p. 64,934.
San Salvador, * Salvador, p. 50,000.
Santander, city, Spain, p. 50,640.
Santiago, * Chile, p. 320,638. — city, Cuba, p. 43,090.
Santo Domingo, republic, isl. of Haiti, □ 18,-045, p. 610,000, * Santo Domingo, p. 14,150.
Sarajevo, * Bosnia and Herzegovina, p. 38,-083.
Saratov, city, Russia, p. 137,109.
Sarawak, ter. on N. W. coast Borneo (Brit.), □ 50,000, p. 500,000, * Kuching.
Saskatchewan, ter. Canada, □ 114,000.
Sas'sari, city, Italy, p. 41,208.
Savannah, Ga., p. 54,244.
Saxe-Altenburg, Ger. duchy, □ 511, p. 194,-273, * Altenburg.
Saxe-Coburg-Gotha, Ger. duchy, □ 755, p. 229,567, * Gotha and Coburg.
Saxe-Meiningen, Ger. duchy, □ 953, p. 250,683, * Meiningen, p. 12,869.

Saxe-Weimar, Ger. grand-duchy, □ 1,388, p. 362,018, • Weimar.
Saxony, Ger. kingdom, □ 5,787, p. 4,199,758, • Dresden.
Schaumburg-Lippe, Ger. principality, □ 131, p. 43,132, • Buckeburg, p. 5,620.
Schenectady, N. Y., p. 31,682.
Schwarzburg-Rudolstadt, Ger. principality, □ 363, p. 92,657, • Rudolstadt, p. 11,907.
Schwarzburg-Sondershausen, Ger. principality, □ 333, p. 80,678, • Sondershausen and Arnstadt.
Schwerin, • Mecklenburg-Schwerin, Germany, p. 36,388.
Scotland, pt. of Great Britain, □ 29,784, p. 4,471,954, • Edinburgh.
Scranton, Pa., p. 102,026.
Seattle, Wash., p. 80,671.
Sebastopol, city, Russia, p. 50,710.
Sendai, city, p. 83,325.
Senegal, Fr. colony, in W. Africa, bet. **Sahara** and R. Gambia, □ 115,800, p. 2,000,000.
Seoul, • Korea, p. 201,000.
Seraing, city, Belgium, p. 39,102.
Servia, kingdom, S. E. Europe, p. 19,050, 2,312,484, • Belgrade.
Sevilla, city, Spain, p. 146,205.
Shahjahinpur, city, India, p. 75,662.
Shanghai, city, China, p. 586,000.
Shansi, prov. China, □ 66,700, p. 12,211,000.
Shantung, prov. China, □ 55,500, p. 36,248,000.
Sheffield, city, Eng., p. 380,717.
Shensi, prov., China, □ 74,000, p. 8,432,000.
Shiraz, city, Persia, p. 50,000.
Sholapur, city, India, p. 74,521.
Siam, kingdom, S. E. Asia, □ 200,000, p. 5,000,000, • Bangkok.
Siberia, prov. Russia, □ 4,833,496, p. 5, 727.090.
Siena, city, Italy, p. 31,367.
Sierra Leon, Brit. W. Africa, crown colony, □ 4,000, p. 74,835, • Freetown, p. 30,033.
Si-gnan-fu, city, China, on Weit R., p. (est.) 750,000.
Sikkim, India, feudatory state in Himalayas, □ 2,818, p. 30,458, • Tumlong.
Silesia, prov. Austria, □ 1,987, p. 680,529.
Sinaloa, state, Mex., □ 33,671, p. 256,858.
Sioux City, Iowa, p. 33,111.
Sivas, city, Asia Minor, p. 43,100.
Smyrna, city, Asia Minor, p. 201,000.
Sofia, • Bulgaria, p. 46,593.
Sokoto' Empire (Fula), included in **Nigeria**.
Sokotra, isl. S. of Arabia (British), □ 1,382, p. 12,000.
Solomon Islands, E. of New Guinea, belong to Germany and Great Britain, □ 12,000.
Somali Coast, Africa, Gulf of Aden, British, □ 68,000, • Berbera, p. 30,000.
Somerset, co., Eng., □ 1,624, p. 385,060.
Somerville, Mass., p. 61,643.
Sonora, state, Mex., □ 76,900, p. 189,158.
South African Republic, Boer Republic, So. Africa, taken by British in 1900. See **Transvaal Colony**.
South America, see **America**.
Southampton, co., Eng., □ 1,466, p. 377,118, — city, Eng., p. 104,911.
South Australia, state, Australia, □ 903,690, p. 362,595, • Adelaide.
South Bend, Ind., p. 35,999.
South Carolina, So. Atlantic state, □ 30,570, p. 1,340,316, • Columbia.

Incorporated cities and towns of 1,000 pop. or more in 1900:

Abbeville	3,766	Cheraw	1,151
Aiken	3,414	Chester	4,075
Allendale	1,030	Clinton	1,869
Anderson	5,498	Columbia	21,108
Bamberg	1,533	Darlington	3,028
Barnwell	1,329	Dillon	1,015
Beaufort	4,110	Edgefield	1,775
Bennettsville	1,929	Florence	4,647
Blacksburg	1,285	Fort Mill	1,394
Blackville	1,116	Gaffney	3,937
Branchville	1,101	Georgetown	4,138
Brookland	1,089	Greenville	11,860
Camden	2,441	Greenwood	4,824
Charleston	**55,807**	**Lancaster**	**1,477**

South Carolina.—Continued.

Laurens	4,029	Spartanburg	11,395
McColl	1,311	Summerville	2,420
Manning	1,430	Sumter	5,673
Marion	1,831	Union	5,400
Mt. Pleasant	2,252	Walhalla	1,307
Newberry	4,607	Walterboro	1,491
Orangeburg	4,455	Winnsboro	1,765
Rock Hill	5,485	Yorkville	2,012

South Dakota, No. Central state, □ 77,650, p. 401,570, • Pierre.

Incorporated cities and towns of 1,000 or more pop. in 1900:

Aberdeen	4,087	Milbank	1,426
Beresford	1,046	Mitchell	4,055
Brookings	2,346	Pierre	2,306
Canton	1,943	Rapid City	1,342
Deadwood	3,498	Sioux Falls	10,266
Dell Rapids	1,255	Spearfish	1,166
Elk Point	1,081	Sturgis	1,100
Flandreau	1,244	Tyndall	1,167
Hot Springs	1,319	Vermilion	2,183
Huron	2,793	Watertown	3,352
Lead City	6,210	Webster,	1,506
Madison	2,550	Yankton	4,125

South Omaha, Neb., p. 26,001.
Southern Rhodesia, (Matabeleland and Mashonaland), So. Africa, □ 192,000, p. 462,-000, • Salisbury.
South Shields, town, Eng., p. 97,267.
Spain, kingdom, S. W. Europe, □ 197,670, p. 18,226,040, • Madrid.
Spandau, city, Prussia, p. 55,841.
Spokane, Wash., p. 36,848.
Springfield, • Ill., p. 34,159, — Mass., p. 62,059, — Ohio, p. 38, 253.
Srinagar, city, India, p. 122,536.
Stafford, co., Eng., □ 1,142, p. 879,618.
Stavropol, city, Caucasus, Russia, p. 41,621.
Steppes, The, prov., Russia, □ 908,073, p. 3,451,385.
Stettin, city, Prussia, p. 210,680.
Stockholm, • Sweden, p. 302,462.
Stockport, town, Eng., p. 78,871.
Straits Settlements, Brit. crown colony, Malay Pen., □ 27,083, p. 512,342, • Singapore.
Strassburg, • Alsace-Lorraine, Germany, p. 150,268.
Stuttgart, • Wurttemberg, Germany, p. 176,-318.
Styria, prov., Austria, □ 8,670, p. 1,356,058.
Suchon, city, China, p. (est.) 500,000.
Sucre, • Bolivia, p. 27,350.
Suffolk (East), co., Eng., □ 859, p. 189,152. — (West), co., Eng., □ 609, p. 117,535.
Sulu Islands, E. of Borneo (U. S.), □ 950, p. 80,000.
Sumatra, isl., Dutch East Indies, □ 161,612, p. 3,209,037.
Sunderland, city, Eng., p. 146,565.
Superior, Wis., p. 31,091.
Surat, city, India, p. 118,364.
Surinam, see Dutch Guiana.
Surrey, co., Eng., □ 707, p. 519,521.
Sussex (East), co., Eng., □ 822, p. 261,691, — (West), co., Eng., □ 629, p. 151,541.
Swansea, city, Wales, p. 94,514.
Sweden, pt. of kingdom of Europe, □ 172,876, p. 5,097,402, • Stockholm.
Sweden and Norway, kingdom, N. Europe, □ 297,321, p. 7,328,797.
Switzerland, republic, Cen. Europe, □ 15,976, p. 3,327,207, • Bern.
Sydney, New South Wales, p. 488,968.
Syracuse, N. Y., p. 108,374, — (St. Siracusa), city, Sicily, p. 26,346.
Syria, Turkish prov., Asia, □ 109,509, p. 3, 317,600.
Szabadka, city, Hungary, p. 72,588.
Szeged, city, Hungary, p. 100,552.

T

Tabasco, state, Mex., □ 10,072, p. 133,926.
Tabriz', city, Persia, p. 180,000.
Tacoma, Wash., p. 37,714.

Taganrog, city, Russia, p. [illegible].
Talca, city, Chile, p. [illegible].
Tamaulipas, state, Mex., ▢ [illegible], p. [illegible].
Tambov, city, Russia, p. [illegible].
Tanjore, city, India, p. [illegible].
Tanta, city, Egypt, p. [illegible].
Tashkend, city, Rus. Turkestan, p. [illegible].
Tasmania, isl., state, Australia, ▢ [illegible], p. [illegible], * Hobart.
Taunton, Mass., p. [illegible].
Tegucigalpa, * Honduras, p. [illegible].
Teheran, * Persia, p. [illegible].
Temesvar, city, Hungary, p. [illegible].
Tennessee, So. Central state, ▢ [illegible], p. [illegible], * Nashville.
Incorporated cities and towns of 1,000 pop. or more in 1900

Athens ...... [illegible]	Lexington 1,222
Bristol ...... [illegible]	McKenzie ...... [illegible]
Brownsville ...... [illegible]	McMinnville ...... [illegible]
Chattanooga ...... [illegible]	Martin ...... [illegible]
Clarksville ...... [illegible]	Memphis 102,320
Cleveland ...... [illegible]	Milan ...... [illegible]
Clinton ...... [illegible]	Morristown ...... [illegible]
Columbia ...... [illegible]	Mt. Pleasant ...... [illegible]
Covington ...... [illegible]	Murfreesboro ...... [illegible]
Dayton ...... [illegible]	Nashville ...... [illegible]
Dyer ...... [illegible]	Newbern ...... [illegible]
Dyersburg ...... [illegible]	Newport ...... [illegible]
Fayetteville ...... [illegible]	Obion ...... [illegible]
Franklin ...... [illegible]	Paris ...... [illegible]
Gallatin ...... [illegible]	Pulaski ...... [illegible]
Greeneville ...... [illegible]	Ripley ...... [illegible]
Harriman ...... [illegible]	Rockwood ...... [illegible]
Humboldt ...... [illegible]	Rogersville ...... [illegible]
Huntingdon ...... [illegible]	Shelbyville ...... [illegible]
Jackson ...... [illegible]	So. Pittsburg 1,790
Jellico ...... [illegible]	Springfield ...... [illegible]
Johnson City ...... [illegible]	Sweetwater ...... [illegible]
Knoxville ...... [illegible]	Trenton ...... [illegible]
Lebanon ...... [illegible]	Tullahoma ...... [illegible]
Lewisburg 1,421	Union City ...... [illegible]
	Winchester ...... [illegible]

Tepic, ter., Mex., ▢ 11,275, p. 146,[illegible].
Terre Haute, Ind., p. [illegible].
Texas, So. Central state, ▢ 265,780, p. 3,048,710, * Austin
Incorporated cities and towns of 1,000 pop. or more in 1900

Abilene ...... [illegible]	El Paso 15,906
Alvarado 1,342	Ennis 4,919
Amarillo 1,442	Farmersville 1,856
Arlington 1,079	Flatonia 1,210
Atlanta 1,201	Fort Worth 26,688
Austin 22,258	Gainesville 7,874
Baird ...... 1,[illegible]	Galveston 37,789
Ballinger 1,178	Gatesville 1,865
Bastrop 2,145	Georgetown 2,790
Beaumont 9,427	Goldthwaite 1,282
Belton 3,700	Gonzales 4,297
Bonham 5,042	Granbury 1,410
Bowie ...... 2,[illegible]	Greenville 6,860
Brenham 5,968	Groesbeck 1,462
Brownsville 6,305	Hallettsville 1,457
Brownwood 3,965	Hearne 2,129
Bryan 3,589	Henrietta 1,614
Burnet 1,003	Hico 1,480
Caldwell 1,535	Hillsboro 5,346
Calvert 3,322	Honey Grove 2,483
Cameron 3,341	Houston 44,633
Cisco 1,514	Hubbard 1,608
Clarksville 2,069	Huntsville 2,485
Cleburne 7,493	Italy 1,061
Coleman 1,362	Itasca 1,277
Columbus 1,824	Jacksboro 1,311
Comanche 2,070	Jacksonville 1,568
Commerce 1,800	Jefferson 2,850
Cooper 1,518	Kaufman 2,378
Corpus Christi 4,703	Kerrville 1,423
Corsicana 9,313	Ladonia 1,409
Crockett 2,612	La Grange 2,392
Cuero 3,422	Lampasas 2,107
Dallas 42,638	Lancaster 1,045
Decatur 1,562	Laredo 13,429
Denison 11,807	Lockhart 2,306
Denton 4,187	Longview 3,591
Dublin 2,370	Lufkin 1,527
Eagle Lake 1,107	Luling 1,349

Texas—Continued.

McGregor ...... [illegible]	Sherman ...... [illegible]
McKinney ...... [illegible]	Smithville ...... [illegible]
Marlin ...... [illegible]	Stephenville ...... [illegible]
Marshall ...... [illegible]	Sulphur Spgs. ...... [illegible]
Mexia ...... [illegible]	Taylor ...... [illegible]
Mineola ...... [illegible]	Temple ...... [illegible]
Mineral Wells ...... [illegible]	Terrell ...... [illegible]
Nacogdoches ...... [illegible]	Texarkana ...... [illegible]
Navasota ...... [illegible]	Tyler ...... [illegible]
New Braunfels ...... [illegible]	Uvalde ...... [illegible]
Oak Cliff ...... [illegible]	Van Alstyne ...... [illegible]
Orange ...... [illegible]	Vernon ...... [illegible]
Palestine ...... [illegible]	Victoria ...... [illegible]
Paris ...... [illegible]	Waco ...... [illegible]
Pittsburg ...... [illegible]	Waxahachie ...... [illegible]
Plano 1,304	Weatherford ...... [illegible]
Quanah ...... [illegible]	Weimar ...... [illegible]
Rockdale ...... [illegible]	Whitesboro ...... [illegible]
Rockport ...... [illegible]	Whitewright ...... [illegible]
Rockwall ...... [illegible]	Wichita ...... [illegible]
San Antonio ...... [illegible]	Wills Point ...... [illegible]
San Marcos ...... [illegible]	Wolfe City ...... [illegible]
Schulenburg ...... [illegible]	Yoakum ...... [illegible]
Seguin ...... [illegible]	

The Hague, * Holland, p. 265,128.
Tibet, depend., Chinese Empire, ▢ 651,500, p. 6,000,000.
Tientsin, city, China, on Peiho R., p. (est.) 1,000,000.
Tiflis, city, Caucasus, Russia, p. 160,645.
Tilburg, city, Holland, p. 40,584.
Tlaxcala, state, Mex., ▢ 1,595, p. 163,244.
Tobago, isl., N. E. of Trinidad, British, ▢ 114, p. 21,400.
Tobolsk, city, Siberia, p. 20,427.
Togoland, Africa, German depend. on Slave Coast, ▢ 33,000, p. 2,500,000, * Lome.
Tokusima, city, Japan, p. 61,501.
Tokio, * Japan, p. 1,440,121.
Toledo, Ohio, p. 131,822.
Tomsk, city, Siberia, p. 52,430.
Tonga (Friendly Islands), Brit. protectorate, ▢ 374, p. 20,000, * Nukualofa.
Tongking (or Tonquin), Fr. posses., Indo-China, ▢ 119,660, p. 12,000,000, * Hanoi, p. 150,000.
Topeka, * Kans., p. 33,608.
Toronto, * prov., Ontario, Canada, p. 207,971.
Toulon, city, France, p. 101,200.
Toulouse, city, France, p. 147,700.
Tourcoing, city, France, p. 73,353.
Tournai, city, Belgium, p. 36,835.
Tours, city, France, p. 63,267.
Toyama, city, Japan, p. 59,558.
Trans-Caucasia, prov., Russia, ▢ 94,182, p. 5,516,139.
Transvaal Colony, So. Africa, British, ▢ 119,139, p. 1,094,156, * Pretoria.
Trapani, city, Italy, p. 51,747.
Trebizond, city, Asia Minor, p. 35,000.
Trenton, * N. J., p. 73,307.
Treviso, city, Italy, p. 36,906.
Trichinopoli, city, India, p. 104,690.
Trieste, city, Austria, p. 178,672.
Trinidad, isl. No. of Orinoco R., British, ▢ 1,754, p. 260,517, * Port of Spain, p. 34,037.
Tripoli, Turkish prov. N. Africa, ▢ 344,000, p. 800,000.
Trondhjem, city, Norway, p. 29,162.
Troy, N. Y., p. 60,651.
Troyes, city, France, p. 52,998.
Tsaritsyn, city, Russia, p. 55,967.
Tucuman, city, Argentine Rep., p. 34,300.
Tula, city, Russia, p. 111,048.
Tunis, Fr. protectorate, N. Africa, ▢ 51,000, p. 1,900,000, * Tunis, p. 153,000.
Turin, city, Italy, p. 359,295.
Turkestan, prov. Russia, ▢ 257,134, p. 3,898,076.
Turkey (or Ottoman Empire) Europe, Asia and Africa, ▢ 1,580,000, p. 40,000,000, * Constantinople.
Turkey, European, ▢ 65,752, p. 6,086,300.
Turkey, Asiatic, ▢ 650,394, p. 17,545,300.
Turkey, African possessions, ▢ 398,900, p. 1,300,000.
Tutuila, isl. Samoa (U. S.), ▢ 54, p. 3,800, * Pago Pago.
Tver, city, Russia, p. 53,477.

Tyrol and Vorarlberg, prov. Austria, □ 11,-324, p. 979,878.

U

Udine, city, Italy, p. 37,628.
Uganda, protectorate, E. Africa, British, 140,000, p. (est.) 3,000,000.
Ulm, city, Wurttemberg, Germany, p. 39,304.
Ulster, prov. Ireland (inc. Antrim, Armagh, Cavan, Donegal, Down, Fermanagh, Londonderry, Monaghan and Tyrone counties), □ 8,613, p. 1,581,351.
Ungava, ter. Canada, □ 456,000.
United Kingdom of Great Britain and Ireland, Europe, □ 120,979, p. 41,454,575, * London.
United States of America, area (ex. Alaska and Hawaii) □ 3,622,933, p. (inc. Alaska and Hawaii) 76,303,387, * Washington.
Upper Austria, prov. Austria, □ 4,631, p. 809,910.
Uralsk, city, The Steppes, Russia, p. 36,597.
Uruguay, republic, So. Am., □ 72,210, p. 900,600, * Montevideo.
Utah, Western state, □ 84,970, p. 276,749, * Salt Lake City.

Incorporated cities and towns of 1,000 pop. or more in 1900:

American Fork	2,732	Mt. Pleasant	2,372
Beaver	1,701	Nephi	2,208
Bountiful	1,442	Ogden	16,313
Brigham	2,859	Park City	3,759
Cedar	1,425	Parowan	1,039
Ephraim	2,086	Payson	2,636
Eureka	3,085	Pleasant Grove	2,460
Fairview	1,119	Provo City	6,185
Fillmore City	1,037	Richfield	1,969
Grantsville	1,058	Richmond	1,111
Heber	1,534	St. George	1,600
Hyrum	1,652	Salt Lake City	53,531
Kaysville	1,708	Sandy	1,030
Lehi City	2,719	Smithfield	1,494
Logan	5,451	Spanish Fork	2,735
Manti	3,408	Spring City	1,135
Mercur	2,351	Springville	3,422
Monroe	1,057	Tooele	1,200
Moroni	1,224		

Utica, N. Y., p. 56,383.
Utrecht, city, Holland, p. 102,040.

V

Valencia, city, Spain, p. 204,768. — city, Venezuela, p. 38,654.
Valladolid, city, Spain, p. 68,746.
Valparaiso, city, Chile, p. 143,022.
Vancouver, city, Brit. Columbia, p. 26,196.
Varna, city, Bulgaria, p. 28,174.
Venezuela, republic, So. Am., □ 593,943, p. 2,444,816, * Caracas.
Venice, city, Italy, p. 157,785.
Vera Cruz, state, Mex., □ 29,201, p. 853,892. — city, Mex., p. 24,085.
Vermont, No. Atlantic state, □ 9,565, p. 343,-641, * Montpelier.

Incorporated cities and towns of 1,000 pop. or more in 1900:

Barre	8,448	Northfield	1,508
Barton	1,050	Proctor	2,013
Bellows Falls	4,337	Randolph	1,540
Bennington	5,656	Richford	1,513
Brattleboro	5,297	Rutland	11,499
Burlington	18,640	St. Albans	6,239
Essex Junction	1,141	St. Johnsbury	5,666
Fair Haven	2,470	Springfield	2,040
Hardwick	1,334	Swanton	1,168
Ludlow	1,454	Vergennes	1,753
Londonville	1,274	Waterbury	1,597
Middlebury	1,897	Windsor	1,656
Montpelier	6,266	Winooski	3,783
Morrisville	1,262	Woodstock	1,284
Newport	1,874		

Verona, city, Italy, p. 71,912.
Versailles, city, France, p. 54,432.
Verviers, city, Belgium, p. 52,496.
Vevey, city, Switzerland, p. 32,982.
Vicenza, city, Italy, p. 44,244.
Victoria, state, Australia, □ 87,884, p. 1,195,-874, * Melbourne.
Vienna, * Austria-Hungary, 4th city of Europe, p. 1,662,269.
Villa Rica, city, Paraguay, p. 25,000.
Vilna, city, Russia, p. 159,568.
Virginia, So. Atlantic state, □ 42,450, p. 1,854,184, * Richmond.

Incorporated cities and towns of 1,000 pop. or more in 1900:

Abingdon	1,306	Manchester	9,715
Alexandria	14,528	Marion	2,045
Ashland	1,147	Martinsville	2,384
Basic City	1,270	Newport News	19,635
Bedford City	2,416	Norfolk	46,624
Berkley	4,988	Petersburg	21,810
Big Stone Gap	1,617	Phoebus	2,094
Bristol	4,579	Pocahontas	2,789
Buena Vista	2,388	Portsmouth	17,427
Cape Charles	1,040	Pulaski	2,813
Charlottesville	6,449	Radford	3,344
Clifton Forge	3,212	Richmond	85,050
Covington	2,950	Roanoke	21,495
Crewe	1,329	Salem	3,412
Culpeper	1,618	Saltville	1,051
Danville	16,520	Scottsville	1,248
Emporia	1,027	Shenandoah	1,220
Falls Church	1,007	Smithfield	1,225
Farmville	2,471	South Boston	1,851
Franklin	1,143	Staunton	7,289
Fredericksburg	5,068	Suffolk	3,827
Front Royal	1,005	Tazewell	1,096
Graham	1,554	Vinton	1,438
Hampton	2,764	Warrenton	1,627
Harrisonburg	3,521	West Point	1,307
Leedsburg	1,513	Williamsburg	2,044
Lexington	3,203	Winchester	5,161
Luray	1,147	Woodstock	1,069
Lynchburg	18,891	Wytheville	3,003

Vitebsk, city, Russia, p. 66,143.
Vitoria, city, Spain, p. 30,514.
Vladikavkaz, city, Caucasus, Russia, p. 43,-843.
Vladivostok, city, Siberia, p. 38,896.
Voronezh, city, Russia, p. 84,146.

W

Wakayama, city, Japan, p. 63,667.
Waldeck, Ger. principality, □ 433, p. 57,913, * Arolsen, p. 2,768.
Wales, pt. of Great Britain, □ 7,441.
Walsall, town, Eng., p. 86,440.
Warrington, town, Eng., p. 64,241.
Warsaw, city, Poland, Russia, p. 638,209.
Warwick, co. Eng., □ 879, p. 347,691.
Washington, Western state, □ 69,180, p. 518,-103, * Olympia.

Incorporated cities and towns of 1,000 pop. or more in 1900:

Aberdeen	3,747	New Whatcom	9,135
Anacortes	1,476	North Yakima	3,154
Ballard	4,568	Olympia	3,863
Blaine	1,592	Port Angeles	2,321
Buckley	1,014	Port Townsend	3,443
Centralia	1,600	Pullman	1,308
Chehalis	1,775	Puyallup	1,884
Colfax	2,121	Republic	2,050
Cosmopolis	1,004	Roslyn	2,786
Davenport	1,000	Seattle	80,671
Dayton	2,216	Snohomish	2,101
Ellensburg	1,737	Spokane	36,848
Everett	7,838	Steilacoom	1,015
Fairhaven	4,228	Tacoma	37,714
Hoquiam	2,608	Vancouver	3,126
Montesano	1,194	Waitsburg	1,011
Mt. Vernon	1,120	Wallawalla	10,049

Washington, D. C., * U. S. A., p. 278,718.
Waterbury, Conn., p. 45,859.
Waterford, city, Ireland, p. 26,743.
Wei-Hai-Wei, city and port, Shantung, prov. China, leased to British (1898), □ 270, p. 118,000.

Weimar, * Saxe-Weimar, Germany, p. 26,-670.
Weisbaden, city, Prussia, p. 74,133.
Wellington, * New Zealand, p. 37,441.
West Bromwich, town, Eng., p. 65,172.
Western Australia, state, Australia, □ 975,-920, p. 182,553, * Perth.
West Ham, city, Eng., p. 267,308.
Westmoreland, co. Eng., □ 783, p. 64,411.
West Virginia, So. Atlantic state, □ 24,780, p. 958,800,* Charleston.
Incorporated cities and towns of 1,000 pop. or more in 1900:

Ansted 1,090	Mannington 1,681
Benwood 4,511	Martinsburg ...7,564
Bluefield 4,644	Monongah 1,786
Buckhannon ...1,589	Montgomery ...1,594
Central City....1,580	Morgantown ...1,895
Ceredo 1,279	Moundsville ...5,362
Charles Town...2,392	New Cumberland 2,198
Charleston 11,099	New Martinsv'e.1,089
Clarksburg 4.050	Parkersburg ..11,703
Davis 2,391	Piedmont 2.115
Elkins 2,016	Point Pleasant..1,934
Fairmont 5,655	Ravenswood 1,074
Grafton 5.650	Shepherdstown .1,184
Guyandot 1,450	Sistersville 2,979
Hinton 3,763	Thomas 2,126
Huntington ...11,923	Wellsburg .....2,[illegible]
Keyser 2,536	Weston 2,560
Keystone 1,088	Wheeling 38,878
McMechen 1,465	

Wheeling, W. Va., p. 38,878.
Wigan, town, Eng., p. 60,770.
Wilkesbarre, Pa., p. 51,721.
Williamsport, Pa., p. 28,757.
Wilmington, Del., p. 76.508.
Wilts, co., Eng., □ 1,375, p. 271,372.
Windward Islands, Brit. West Indies (comprise Grenada, St. Vincent, the Grenadines and St. Lucia), total area □ 508, p. 159,793.
Winnipeg, * prov. Manitoba, Canada, p. 42,-336.
Wisconsin, No. Central state, □ 56,040, p. 2,069,042, * Madison.
Incorporated cities and towns of 1,000 pop. or more in 1900:

Algoma 1,738	Fond du Lac..15,110
Alma 1,201	Fort Atkinson..3,043
Antigo 5.145	Fountain City..1,031
Appleton 15,085	Glenwood 1,789
Arcadia 1,273	Grand Rapids...4,493
Ashland 13,074	Green Bay.....18,684
Augusta 1.256	Hartford 1.632
Baraboo 5,751	Horicon 1,376
Barron 1.493	Hudson 3.259
Bayfield 1,689	Janesville 13.185
Beaverdam 5.128	Jefferson 2.584
Beloit 10,436	Kaukauna 5.115
Berlin 4,489	Kenosha 11,606
Black River Falls 1,938	Kewaunee 1,773
Boscobel 1,637	Kilbourne City.1.134
Brodhead 1,584	La Crosse......28,895
Burlington 2.526	Lake Geneva...2,585
Cedarburg 1,626	Lake Mills......1,387
Chilton 1,460	Lancaster 2,403
Chippeway F'ls.8,094	Lodi 1.068
Clintonville 1,653	Madison 19.164
Columbus 2.349	Manitowoc 11,786
Cudahy 1.366	Marinette 16,195
Cumberland ...1.328	Marshfield 5,240
Darlington 1,808	Mauston 1,718
Delavan 2,244	Mayville 1,815
Depere 4.038	Medford 1,758
Dodgeville 1,865	Menasha 5,580
Durand 1.458	Menominee 5,655
Eau Claire.....17,517	Merrill 8,537
Edgerton 2,192	Milwaukee ...285,315
Elkhorn 1,731	Mineral Point...2,991
Ellsworth 1,052	Mondovi 1,208
Elroy 1,685	Monroe 3,927
Evansville 1,864	Necedah 1.209
Fennimore 1,035	Neenah 5,954
	Neillsville 2,104

Wisconsin.—Continued.

New Lisbon.....1,014	Sheboygan 22,962
New London....2,742	Sheboygan Falls 1,301
New Richmond 1,631	Shullsburg 1,250
North Milwaukee 1,049	South Milwaukee 3,392
Oconomowoc ...2,880	Sparta 3,555
Oconto 5,646	Spring Valley...1,021
Omro 1,358	Stanley 2,387
Onalaska 1,368	Stevens Point...9,524
Oshkosh 28.284	Stoughton 3,431
Phillips 1,820	Sturgeon Bay...3,372
Platteville 3,340	Superior 31,091
Plymouth 2,257	Tomah 2,840
Portage 5,459	Tomahawk 2,291
Port Washington 3,010	Two Rivers.....3,784
Prairie du Chien 3,232	Viroqua 1,950
Prescott 1,002	Waterloo 1.137
Princeton 1,202	Watertown 8,437
Racine 29,102	Waukesha 7,419
Reedsburg 2,225	Waupaca 2,912
Rhinelander ...4.998	Waupun 3,185
Rice Lake.......3.002	Wausau 12,354
Richland C'nt'r.2,321	Wauwatosa 2,842
Ripon 3,818	West Bend......2,119
River Falls.....2,008	Whitewater 3,405
Seymour 1,026	Winneconne ...1,042
Shawano 1,863	

Woonsocket, R. I., p. 28,204.
Worcester, Mass., p. 118,421. — co. Eng., □ 740, p. 358,356. — Its * p. 46,623.
Worms, city, Hesse, Germany, p. 33,175.
Wuhu, city, China, on Yangtse R., p. 85,000.
Wurttemberg, Ger. kingdom, □ 7,528, p. 2,-165,765, * Stuttgart.
Wurzburg, city, Bavaria, Germany, p. 68,747.
Wyoming, Western state, □ 97,890, p. 92,531, * Cheyenne.
Incorporated cities and towns of 1,000 pop. or more in 1900:

Cheyenne 14,087	Rawlins..........2,317
Evanston 2,110	Rock Springs...4,363
Green River....1.361	Sheridan 1,559
Laramie 8,207	

Y

Yarmouth, Great, town, Eng., p. 51,250.
Yaroslovl, city, Russia, p. 70,610.
Yeisk, city, Caucasus, Russia, p. 35,446.
Yekaterinburg, city, Siberia, p. 55,488.
Yekaterinodar, city, Caucasus, Rus., p. 65,-697.
Yekaterinoslav, city, Russia, p. 121,216.
Yemen, Turkish prov. Arabia, □ 77,200, p. 750,000.
Yezd, city, Persia, p. 45,000.
Yonkers, N. Y., p. 47,931.
Yokohoma, city, Japan, p. 193,762.
York, Pa., p. 33,708 — co. Eng. (E. W. and N. Ridings), □ 5,939, p. 1,891,726. — Its * p. 77,793.
Youngstown, Ohio, p. 44,885.
Yucatan, state, Mex., □ 35.203, p. 297,088.
Yukon, ter. Canada, □ 198,300.
Yunnan, prov. China, □ 155,000, p. 11,722,000.

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Zacatecas, state, Mex., □ 24,757, p. 447,265. — Its * p. 32,856.
Zagazig, city, Egypt, p. 35,715.
Zagrab, city, Hungary, p. 57,930.
Zanzibar Protectorate (including islands of Zanzibar and Pemba), British, □ 1,020, p. 200,000, * Zanzibar, p. 30,000.
Zaragoza, city, Spain, p. 98,188.
Zhitomir, city, Russia, p. 55,452.
Zittau, city, Saxony, p. 28,132.
Zululand, prov. of Natal, So. Africa, □ 10,470.
Zurich, city, Switzerland, p. 150,239.
Zwickau, city, Saxony, p. 50,391.

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